LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

BACKGROUND DOCUMENTATION REPORTS

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

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AFFECTED ENVIRONMENT

Information for the following descriptions has been taken from the open literature, Environmental Impact Statement (EIS) studies, and personal and telephone interviews. Open literature and EIS studies are cited in the text.

Threatened or endangered species are within the realm of the biological assessment relating to Section 7 Consultation. No consideration of present or potential impacts on any of these species is included.

Trunkline

Three major rivers are crossed by the proposed trunkline route: the White River, Yampa River, and Little Snake River.

White River, Colorado. MP 37. The White River occurs on the White River Plateau, and has an average annual discharge of 420,000 acre feet (Carlson et al. 1979). The confluence of Piceance Creek and the White River occurs adjacent to the proposed crossing. This confluence is the general separation point of fishery resources in the White River (BLM 1980). Upstream from this point is the trout fishery, while in this area and downstream the fish component of the aquatic biota consists of channel catfish and black bullheads (BLM 1980).

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       5. PUBLIC LANDS--COLORADO.
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Intensive collections made at a station near the proposed crossing (Carlson et al. 1979) included roundtail chubs, bluehead and flannelmouth suckers, black bullheads, channel catfish, mountain whitefish, fathead minnows, speckled dace, carp, and mottled sculpins.

Yampa River, Colorado. MP 70.5. The Yampa River is a major northwest Colorado stream with an average annual discharge of 1.2 million acre feet (Carlson et al. 1979). The Yampa River contains a local channel catfish fishery in the area of the proposed crossing. Some rainbow trout may exist in the area; their major concentration is upstream of the proposed crossing. Brown trout are present in some localized stream segments in the proposed crossing area.

Carlson et al. (1979) established a collecting station on the Yampa River near the proposed crossing. Intensive sampling over several periods collected rainbow trout, carp, white, bluehead, and flannelmouth suckers, roundtail chubs, mottled sculpins, speckled dace, fathead minnows, sand shiners, and redside shiners.

Little Snake River, Colorado. MP 109. The proposed trunkline route crosses the Little Snake River about 5 miles southwest of Baggs. It is an often turbid stream characterized by low productivity with occasional occurrences of noxious wastes. Mountain whitefish, chubs, carp, suckers, and channel catfish are known to be present in this river segment. There is no stocking at the present time.

Several perennial streams are also crossed by the proposed trunkline route. Fishery potential of all of these creeks was researched.

Piceance Creek, Colorado. MP 16.2, 30.9. No sports fishery exists in Piceance Creek at the proposed crossing sites. Some trouts exist in the drainage, but are in tributaries or mainstream in the reaches

upstream of the proposed crossings. Some whitefish may be present. Species taken in Piceance Creek included speckled dace, white suckers, and fathead minnows (BLM 1979).

Spring Creek, Colorado. MP 71.0. Spring Creek has no fishery. Its waters may be used by such local species as roundtail chubs for spawning.

Muddy Creek, Wyoming. Muddy Creek is contacted at two places (about MP 135 and 144) by the proposed trunkline. It is a low production stream of only local importance where the water is often turbid and noxious wastes may occur. Roundtail chub, flannelmouth sucker and mountain sucker are present; however, a long-term fishery cannot be maintained here by either natural or artificial means.

Separation Creek, Wyoming. MP 182. Separation Creek is a very low production stream probably incapable of sustaining a fishery.

Sand Creek, Wyoming. This crossing is located about 5 miles northeast of Ferris (about MP 215). This is at the headwaters of the stream where it has a very low productivity and doesn't become able to support a fishery until about a mile downstream from the pipeline crossing.

Sweetwater River, Wyoming. MP 234. The Sweetwater River is a low production stream of local importance.

Horse Creek, Wyoming. MP 238. Horse Creek is a low production stream of local importance.

Fish Creek, Wyoming. MP 242. Located about 12 miles WNW of Alcova, Fish Creek is characterized by low productivity and has only local

importance. The water is often turbid. Noxious waters may occur. Of its 8-1/2 mile length, only 1-1/2 miles of Fish Creek is suitable for fisheries. Brook trout are present with a stable or increasing population, upstream of the proposed crossing.

Casper Canal, Wyoming. MP 262. This is a low production stream probably incapable of sustaining a fishery.

The Wyoming Game and Fish Department has developed a stream classification system (WGFD 1977) based on three criteria: esthetics, availability and productivity. Streams are rated numerically from 1 to 5 in each category. The criteria are weighted and the sum of the weighted values defines the appropriate class. The classes are: Class 1 (Value 31-35)--Premium trout waters--fisheries of national importance; Class 2 (Value 25-30)--Very good trout waters--fisheries of statewide importance; Class 3 (Value 18-24)--Important trout waters --fisheries of regional importance; Class 4 (Value 11-17)--Low production waters--fisheries frequently of local importance but generally incapable of sustaining substantial fishing pressure; and Class 5 (Value 7-10)--Very low production waters--often incapable of sustaining a fishery.

All Wyoming watercourses crossed are Class 4 or 5 streams. Class 4 includes the Little Snake River (just upstream of the crossing in Colorado), Muddy Creek, Sweetwater River, Horse Creek, and Fish Creek. Class 5 streams are Separation and Sand creeks and the Casper Canal.

Several intermittent streams are crossed by the proposed trunkline and Rangely lateral alternatives. By definition these streams only contain water intermittently in time or space, or both. Some fish utilization of intermittent streams may occur, for forage or

spawning. Such use could largely occur only during the spring when flow is present. No construction is planned at that time.

Pump Stations

No waterways are present at the proposed pump station locations.

Alternatives

Southern Rangely Lateral. One major stream is crossed by the Southern Rangely Lateral Alternative route, the White River (MP 40.8). Fish resources of the White River have been described under the proposed trunkline route. Fishery resources of the minor perennial streams crossed by this alternative route are negligible.

Northern Rangely Lateral. One major stream is crossed by this Rangely lateral alternative route, the White River (MP 26.0). Fish resources of the White River have been described under the proposed trunkline route. Spring Creek, Colorado (MP 24.4) and Stinking Water Creek (MP 35.3) are mapped as perennial streams. Spring Creek is intermittent, however, with little if any fish utilization. Stinking Water Creek contains no fish.

White River Alternative. The White River Alternative crossing lies in the same aquatic habitat with the same fish fauna expected as given in the discussion of the proposed trunkline route.

Yampa River Alternative. The Yampa River Alternative crossing lies in the same aquatic habitat with the same route fauna expected as in the discussion of the proposed trunkline route. Spring Creek, which may be used by local fishes such as roundtail chub for spawning, would not be affected by this alternative route.

Threatened or Endangered Fishes

Endangered or threatened fish species are being considered on a case-by-case basis as part of the U.S. Fish and Wildlife Service Section 7 Consultation.

ENVIRONMENTAL CONSEQUENCES

Analytical Criteria

Two criteria were used in determining the level of significance:

1) Each permanent stream intersected was analyzed to determine the relative extent of habitat disturbance which is expected to result from the proposed action. If no more than one percent of the total available crucial habitat within the geographic area (generally a 20-mile wide corridor) is expected to be disturbed by the proposed action, then the significance of that impact was considered to be low. If it was determined that more than one percent of the total would be disturbed, the impact analysis was conducted in further depth to identify any possible indirect impacts.

2) This criterion was applied if a finding of significance was made from criterion 1 (greater than one percent disturbance). When the amount of disturbance was found to be greater than one percent, further analysis was conducted to determine whether the disturbance would create beneficial or adverse impacts, and short- or long-term impacts to the wildlife resources. For purposes of this determination, the following definitions were employed.

Short-term: lasting one year or less or affecting recruitment of only one generation (year-class) of animals.

Long-term: lasting more than one year or affecting recruitment of more than one generation of animals.

Construction Impacts

No stream or river crossing is anticipated to affect more than one percent of the total available habitat within the geographic area. No significant impacts are anticipated by the proposed action.

Generalized Impacts

Construction of pipeline crossings at permanent rivers and streams is expected to have minor effects on fish populations and other aquatic organisms in the immediate vicinity of the construction site and for a limited distance downstream. These effects may include the loss of a few fish during construction but generally consist of habitat deterioration resulting from increased sediment loads. Stream sedimentation is expected to increase downstream from the disturbance as a result of alteration of stream banks, removal of streamside vegetation, and disruption of the stream bottom during ditching. Such disturbances would be temporary since construction at the stream crossings would normally be completed within a few days. The amount of sediment at each crossing would be relatively small since construction disturbance would be limited to about 250 feet of each stream bank. The greatest adverse impact that could result is if vegetation does not reestablish as anticipated.

A direct effect of construction of the pipeline across riverbeds would be the temporary loss of 55.5 square yards of benthic substrate, and its concomitant fish food potential, for each 10 feet of river

crossed. The approximate fish food quantity, in the form of benthic invertebrates, expected to occupy that area of substrate would weigh no more than 3.5 (dry weight) pounds (calculated from various benthic studies by Neves 1979; Bane and Lind 1978; Andrews and Mishall 1979). While an estimation, this figure is selected as the higher end of any range of values. If a fish is assumed to be 15 percent efficient in converting its food to flesh, also an estimate on the higher side of any range of values, then approximately 0.5 (dry weight) pounds of fish flesh would be lost for every 10 feet of river crossed. This impact is expected to be localized, short-term and, therefore, insignificant.

General construction activity in close proximity to rivers and streams in addition to construction activity directly in the riverbeds would increase stream turbidity. Extensive literature is available regarding the biological effects of increased turbidity and it has been generally demonstrated that stream productivity is adversely affected throughout all trophic levels (Karr and Schlosser 1978; Stern and Stickle 1978; Cordone and Kelly 1961, et al.). While it has been reported that high levels of suspended solids can have severe physical effects on fishes under laboratory conditions (Herbert and Merkens 1961; Herbert and Richards 1963; Horkel and Pearson 1966), it has been shown that under natural conditions fishes do not remain in areas of high turbidity (Herbert et al. 1961; Peters 1967; Burnside 1967; Gammon 1970). Additionally, western streams are characteristically turbid for at least parts of the year, and native fish species have adapted to such conditions.

It is anticipated that adult and juvenile fishes would move away from areas of turbidity, and that direct effects of turbidity would be insignificant.

The indirect effect of reducing reproductive success could result from river crossing construction activities. Suspended sediments can disrupt reproduction by covering spawning grounds (Karr and Schlosser 1978), by preventing the removal of metabolic wastes from the substrate and by preventing the entrance of oxygen-rich water into the substrate (Cooper 1965; Sheridan and McNeil 1968; Meehand and Swanston 1977), all of which can result in fish egg and larval mortality as high as 85 percent (Shelton and Pollock 1966). It is anticipated that these impacts on reproductive success would be localized, short-term and biologically insignificant unless river crossing construction coincides with the period of major fish spawning activity (March to June). The proposed action is not currently scheduled to occur during these months. The exception to this period of spawning is fall spawning species. Brown trout are fall spawners, and occur in the Yampa River near the proposed crossing. Interviews with local fishery biologists found that while some brown trout do occur, the resource is not sufficiently large to be significantly affected by the proposed action.

Temporary removal of benthic substrate would probably result in the loss of 3.5 (dry weight) pounds of benthic macroinvertebrates for every 10 feet of river crossed (see discussion above). While the effect of such habitat disturbance could be locally significant, it is anticipated that benthic population recovery and reestablishment in the disturbed area would be complete within a few months of the termination of construction activity. This recovery has been discussed by Hynes (1970) and recently documented by Gore and Johnson (1979). The phenomenon of behavorial drift, detailed in Waters (1969, 1972) allows rapid recovery of such disturbance. Disturbed benthic habitat and upstream habitat are sufficiently homogeneous to allow potential colonizers in the drift. In general the crossings will be short-term and the effects are expected to be similar to those resulting from a summer thunderstorm.

The cumulative effects of macroinvertebrate habitat disturbance and stream siltation are anticipated to be localized and of short-term duration. Complete recovery of invertebrate populations would be expected within a year of the termination of construction.

Operational Impacts

Operation of the pipeline would have no effects on the aquatic environment.

Pump Stations

Construction or operation of pump stations is not anticipated to have significant effects on aquatic habitat, as no such habitats occur on the proposed pump station sites. Some sediment runoff may occur, as discussed in Generalized Impacts.

Alternatives

Neither the White River Alternative crossing nor the Yampa River Alternative crossing would have a significant effect, as described by criterion 1. The same generalized impacts would be expected as discussed above (Generalized Impacts).

The No-Action Alternative would have no significant impact, as determined by criterion 1. No generalized impacts would occur.

Threatened or Endangered Fishes

Endangered or threatened fish species are being considered on a case-by-case basis as part of the U.S. Fish and Wildlife Service Section 7 Consultation.

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CLIMATE, AIR QUALITY, AND NOISE
BACKGROUND DOCUMENTATION REPORT

for

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Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL
CLIMATE, AIR QUALITY AND NOISE
BACKGROUND REPORT

AFFECTED ENVIRONMENT

Climate

The general climate of the project area can be classified as continental. The proposed trunkline would extend from western Colorado through the Great Divide Basin into the rolling hills of central Wyoming. The significant changes in topography and elevation are expected to result in significant microclimatic changes. Thus, local conditions would be expected to determine the climate at any one given site. For example, local wind patterns can vary due to topographical effects. In addition, temperature changes may result from changes in elevation and exposure.

Data from the meteorology and air quality monitoring stations near the proposed trunkline and alternative routes are discussed below.

Precipitation. Annual precipitation decreases northward from the southern end of the proposed trunkline to Baggs, Wyoming and then begins to increase again. The northern terminus of the proposed trunkline receives about 12 inches per year of precipitation.

Table 1 contains precipitation data from several stations near the proposed trunkline and alternatives. Tract C-a data are low in relation to the other listed stations. This station's data are a

Table 1. MEAN PRECIPITATION (INCHES) NEAR THE PROPOSED TRUNKLINE AND ALTERNATIVE ROUTES

Station	(Elev ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Grand Junction, CO[a]	4843	0.60	0.58	0.76	0.75	0.72	0.44	0.61	1.04	0.90	0.91	0.60	0.59	8.50
Tract C-a, CO[a]	6300 to 7300	0.13	0.27	0.39	0.39	0.86	0.77	0.53	0.45	0.25*	0.34*	0.12	0.10	4.59
Near Parachute, CO[b]	5000 to 7250	1.17	1.11	1.03	1.09	1.11	1.06	0.73	1.01	1.37	1.17	1.12	1.40	13.37
Dixon[c]	6359	0.91	0.67	0.92	1.18	1.25	1.09	0.99	1.07	0.96	1.25	0.78	0.98	12.05
Rawlins[c]	6736	0.47	0.55	0.67	1.06	1.18	0.90	0.71	0.66	0.78	0.82	0.50	0.54	8.84
Seminole Dam[c]	6838	0.63	0.75	1.08	1.81	1.99	1.48	0.84	0.69	0.87	1.08	0.78	0.68	12.72
Saratoga[c]	6786	0.45	0.39	0.70	1.06	1.18	1.15	0.88	0.90	0.88	0.96	0.51	0.48	9.60
Pathfinder Dam[c]	5930	0.32	0.40	0.64	1.21	1.67	1.39	0.78	0.63	0.80	0.93	0.45	0.36	9.60
Casper 2E[c]	5195	0.57	0.57	0.99	1.93	2.50	1.71	0.95	0.67	1.02	1.20	0.85	0.55	13.56
Casper AP[c]	5320	0.51	0.52	0.93	1.61	2.04	1.30	0.98	0.56	0.90	0.97	0.66	0.49	11.40

*Incomplete data

[a]Gulf (1977): Feb. 1975 through Jan. 1977.

[b]Union (1976): 1959 through 1974.

[c]BLM (1980): Various periods greater than 20 years.

summary of only two years' data, so it may be unrepresentative of long-term precipitation. The proposed trunkline route has relatively low precipitation due to the effective mountain barriers; westerly and northwesterly winds from the Pacific Ocean are blocked by the Cascades, Sierra Nevada, and Rocky Mountains. Most precipitation results from moisture-laden easterly winds, particularly in the spring.

Monthly and annual temperatures are tabulated in Table 2. There is a decreasing temperature trend from the northern reaches of the proposed route to the Wyoming-Colorado border, with the southern portion somewhat warmer.

Although topography precludes the validity of generalizations on a microscale, the pipeline route has an annual temperature of 40 to 50°F, with a frost-free season of 6 to 8 months.

Air Quality

The proposed trunkline route would cross portions of two states and three air quality control regions, as designated by the U.S. Environmental Protection Agency. All areas are currently classified as being in attainment of ambient standards for all criteria pollutants.

Air quality data are limited along the route due to its rural setting. Total suspended particulates are measured at a number of stations (Table 3). The federal primary annual standard is exceeded only at the Rifle and Craig, Colorado stations. Since these stations are in a more urban area, these data are not considered representative of the project area, since they are likely to be higher than most of the areas along the route.

Table 2. MEAN MONTHLY AND ANNUAL TEMPERATURES (°F) NEAR THE PROPOSED TRUNKLINE AND ALTERNATIVE ROUTES

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Grand Junction, CO[a]	26	33	43	52	62	72	78	76	67	54	40	28	53
Near Parachute, CO[b]	—	—	—	—	—	—	—	—	—	—	—	—	47
Tract C-a[c]	—	—	—	—	—	—	—	—	—	—	—	—	42
Dixon, WY[a]	18	22	30	41	51	58	65	63	54	44	30	21	41
Rawlins, WY[a]	21	24	29	39	50	60	67	65	55	44	30	23	42
Seminole Dam, WY[a]	21	24	29	40	50	60	69	67	58	46	32	24	43
Pathfinder Dam, WY[a]	22	25	31	42	52	62	71	69	59	48	34	26	45
Saratoga, WY[a]	22	25	30	40	50	59	66	64	55	45	32	24	43
Casper 2E, WY[a]	27	30	35	44	55	64	72	70	59	49	36	29	48
Casper A.P., WY[a]	23	27	32	42	52	62	71	69	58	47	33	26	45

[a] BLM (1980): Various periods greater than 20 yrs.

[b] Union (1976): 1959 through 1974.

[c] Gulf (1977): Feb. 1975 through Jan. 1977.

Table 3. SUSPENDED PARTICULATE SUMMARY NEAR THE PROPOSED TRUNKLINE AND ALTERNATIVE ROUTES ($\mu g/m^3$)

Site	(Yr)	Geo. Mean	Max	Min
Rio Blanco[a]	(73)	14	144	3
	(75)	13	111	2
Rangely[a]	(73)	31	168	6
	(75)	43	290	5
	(78)	54	285	7
Craig[a]	(73)	67	220	5
	(75)	80	322	12
	(76)	119	-	-
	(77)	102	-	-
	(78)	98	322	23
Grand Valley[a]	(73)	39	278	7
	(75)	52	185	9
	(78)	55	213	4
Rifle, CO[a]	(73)	91	339	21
	(75)*	79	155	23
	(76)	132	-	-
	(77)	108	-	-
	(78)	120	494	23
Nr. Parachute, CO[b]	(2-75 thru 1-77)	12	-	-
Savery[c]	(79)*	19	63	3
Baggs[c]	(78)	64	179	26
Rawlins/Sinclair[c]	(77)	20	49	4
	(78)*	16	67	6
Rawlins, WY[c]	(75)*	16	43	2
	(76)	39	200	9
Casper, WY[c]	(59)	66	161	22
	(79)*	41	97	3
	(79)*	36	108	9
Casper, WY[c]	(76)	51	156	4
	(77)	59	164	4
	(78)*	31	136	8

Note: Prior to 1979 measurements made at ambient temperature and pressure.

*Partial year data.

[a]Colorado (1974, 1976, 1978, 1979)

[b]Gulf (1977)

[c]Wyoming (1972, 1976, 1977, 1978, 1979)

Gaseous pollutants are even less frequently monitored in the rural areas near the route. Measurements are made in Denver, but they would not be applicable to the route. Table 4 lists ozone concentrations at two Wyoming sites and one Colorado site. The federal primary standard of 0.12 ppm is not exceeded in any case, but the Colorado standard of 0.08 ppm was exceeded at least once. Ozone is not expected to be a problem in rural environments, as these few measurements indicate.

Assumptions and Assessment Guidelines. Impacts on climate, air quality, and noise were assessed for the proposed action and alternatives according to the following guidelines:

- Impacts on climate were considered significant if a change to any climatic parameter would occur on a scale larger than the microscale.

- Air quality impacts were considered significant if emissions from the action would be of a long-term nature and would be greater than significance levels specified in federal regulations for prevention of significant deterioration (40 CFR 52.21).

- Noise impacts were considered significant if the public would be exposed to noise levels in excess of 55 decibels, Ldn scale.

ENVIRONMENTAL CONSEQUENCES

Proposed Action

Construction. Impacts from construction of the proposed trunkline, Rangely lateral, storage tanks, and pump stations would consist of temporary increases in concentrations of fugitive dust and gaseous

Table 4. OZONE SUMMARY[a,b] NEAR THE PROPOSED TRUNKLINE AND ALTERNATIVES (PPM)

	Arith Mean	Max	Min	# of OBS
Tract C-a[a] (2-76 thru 1-77)	0.034	0.068	0.002	-
Tract C-a[a] (2-75 thru 1-76)	0.032	0.089	0.0	-
Patrick Draw[b] (78)	0.03	0.07	0.0	5517
Douglas North[b] (78)	0.03	0.07	0.0	5344

[a]Gulf (1977)

[b]Wyoming (1978)

pollutants. In areas along the pipeline routes where natural, wind-blown dust leads to occasional high concentrations of total suspended particulate (TSP), construction activities would contribute to high levels during periods of strong wind. However, construction impacts would be temporary, transient, and localized, and would not be expected to have a significant impact on long-term or regional air quality. Emission factors used to estimate emissions are presented in Appendix A-1, and estimates of pollutant emissions during a worst-case construction scenario are presented in Appendix A-2.

Construction impacts would also include temporary increases in noise levels in the project area. These increases would result from the operation of construction equipment and trucks used to transport materials to the construction site. Heavy equipment and construction activities typically produce noise levels of about 90 decibels at a distance of 50 feet (EPA 1974). These levels would decrease to the level of a normal conversation, about 60 decibels, within about one-quarter of a mile, assuming an attenuation rate of 6 decibels per doubling distance (Bragdon 1971). In addition truck traffic on public highways would increase due to pipe transportation. These impacts would be limited to a time frame of approximately two weeks. Highway trucks traveling between 35 and 65 miles per hour typically result in sound levels of 80 to 90 dBA at 50 feet (EPA 1971). These sound levels would result in the 60 dBA isopleth extending from approximately one-tenth to one-quarter mile on either side of the highway. In the case of indoor activities, buildings 100 feet from the roadway would themselves attenuate the sound levels below 60 dBA within the structure. These impacts would be temporary and transient, and would not be expected to have a significant impact on long-term or regional noise levels. The methodology used to estimate increases in noise levels is presented in Appendix A-4.

Operation. No significant impact on climate, air quality, or noise would be expected during operation of the proposed project. No air pollutants would be emitted from the pipeline or the electrically-operated pump stations in significant amounts. Hydrocarbon emissions from the storage tanks would be small because of the use of double-seal, floating roof tanks. Operational emission estimates are presented in Appendix A-3.

The pipeline pump stations would use electric, motor-driven pumps. Operation of these pumps would result in some increase in ambient noise levels; however, because of the relatively small size of the motors and the rural location of the pump stations, no significant impact on noise levels would be expected.

APPENDIX A

CLIMATE, AIR QUALITY, AND NOISE

This appendix contains the emission factors used to calculate construction emission estimates (Appendix A-1) and discussions of the methodology and assumptions used in estimating emissions from construction and operation of the proposed project (Appendix A-2 and Appendix A-3, respectively). Appendix A-4 presents the methodology used to estimated increases in noise levels associated with the proposed project.

APPENDIX A-1
EMISSION FACTORS

Construction activities related to pipeline digging and burial operations would be the primary source of pollutant emissions during construction. At present there are no emission factors specifically applicable to pipeline digging and burial operations. An estimate of the amount of fugitive dust that might be generated can be obtained using emission factors derived for storage pile operations. Both operations--storage pile maintenance, and pipeline digging and burial--generate dust from the initial disturbance of material when a pile of earth is formed, from wind erosion of the exposed site, and from the final disturbance during backfilling operations.

Storage pile maintenance operation emission factors are based on a two-week cycle. Pipeline burial operations are expected to have a cycle-time of less than two weeks, thus emissions estimates should be conservative. Emissions are proportional to the volume of soil put through the soil removal, storage, and backfilling cycle and were based on an emission factor of 0.22 pounds of particulates per ton of earth cycled (Cowherd et al. 1974).

For construction areas, an emission factor of 1.2 tons per acre per month has been published (EPA 1978a). This factor was developed from data collected in the vicinity of construction sites in a semi-arid climate, with soils of moderate silt content and assuming medium levels of construction activity. The climatic conditions, soil com-

position, and construction activity levels along the proposed pipeline right-of-way (ROW) are expected to be conservatively approximated by conditions used in establishing this emission factor. Since up to four construction crews will be working concurrently, construction emissions are calculated on a per construction spread basis.

Initial clearing of ROW for pipeline construction will result in some increase in fugitive dust due to wind erosion of exposed surfaces. The following emission factor has been suggested by PEDCO (1976):

$$E = AIKCL'V'$$

where

E = Emission factor (ton/acre/year) = 1.92
A = Portion of losses that become suspended = 0.041 (assumed)
I = Soil erodibility = 134 (assumed)
K = Surface roughness factor = 1.0 (assumed)
C = Climatic factor = 0.5 (assumed)
L' = Unsheltered field width factor = 0.7 for 1000 feet
V' = Vegetative cover factor = 1.0 (assumed)

These values should provide a conservative estimate of actual wind erosion emissions.

Gaseous emissions for the construction fleet were calculated using emission factors for heavy- and light-duty construction vehicles and equipment. These factors have been published by the EPA (1978a) in the Compilation of Air Pollutant Emission Factors (publication AP-42).

APPENDIX A-2

CONSTRUCTION EMISSIONS

Construction emissions were computed from the previously derived emission factors and available construction data. For fugitive dust emission estimates, only 50 percent of any given construction area was assumed to be active at any one time. For pipeline construction, 7 miles of pipeline was assumed to be actively worked at any one time by a single construction crew, and a 50-foot active ROW was considered. The pipeline burial rate was assumed to be about one mile per day, per crew. Construction work would take place six days per week, ten hours per day. These assumptions were used for calculating construction emissions for both the proposed trunkline and the Rangely lateral.

Estimates of fugitive dust emissions for pipeline burial were based on the expected volume of earth disturbed per active day. A pipeline burial rate of one mile per active day, per crew was used in association with the maximum proposed ditch dimensions to provide a conservative estimate of emissions along the proposed trunkline route.

For computing emissions due to wind erosion of exposed areas, it was assumed that 7 miles of a 50-foot-wide ROW would be actively exposed each day, and that reclamation activities would begin immediately after pipeline burial.

Fugitive dust emissions estimated for each phase of the project are presented in Table A.2-1.

Gaseous emissions were calculated by multiplying the emission factors (in pounds of pollutant per hour) by the estimated time of use for each piece of equipment in the construction fleet. It was assumed that any one piece of equipment was active for only half the working period. Gaseous emissions for a worst-case construction scenario are given in Table A.2-2.

Air pollutant emissions due to pipeline construction activities were calculated by applying the emission factors and assumptions as described below.

1. Pipeline Construction (ROW clearing)

   1.2 tons/acre/month x 50 ft$^{(1)}$ right-of-way x 7 active miles$^{(2)}$ x 5280 ft/mile x 1 acre/43560 ft^2 x 1 month/30 day x 0.5 active area/total area$^{(3)}$ x 76 days construction per crew$^{(4)}$= 64.5 tons of dust per crew (uncontrolled)

   (1) The active ROW would be 50 feet
   (2) It was assumed that a 7-mile strip would be actively worked at any one time
   (3) 50 percent of the total area was assumed to be actively worked at any one time
   (4) A construction rate of 1 mile per day per crew was assumed

Table A.2-1. UNCONTROLLED FUGITIVE DUST EMISSIONS DURING PIPELINE CONSTRUCTION (tons per year)

Activity	Fugitive Dust Emissions Per Crew	Fugitive Dust Emissions Project Total
Pipeline Construction (right-of-way clearing)	64.5	258.0
Pipeline Burial	52.2	220.8
Wind Erosion from Exposed areas	81.5	326.0
TOTAL	201.2	804.8

Table A.2-2. GASEOUS EMISSIONS FOR A WORST-CASE CONSTRUCTION SCENARIO (tons)

Pipeline Construction and Burial	CO	HC	NO_x	SO_2	TSP
Per Construction Crew	3.3	1.1	16.5	1.1	0.9
Project	13.2	4.4	66.0	4.4	3.6

2. Pipeline Digging and Burial

0.22 lbs of dust/ton of soil cycled x 100 lbs/soil/ft^3 (1) x 5 ft(2) x 5 ft(3) x 5280 ft/day(4) x 1 ton soil cycled/2000 lbs soil cycled x 1 ton dust/2000 lbs dust x 76 days of construction per crew(4)= 55.2 tons of dust (uncontrolled)

(1) assumed soil density
(2) assumed ditch width
(3) assumed ditch depth
(4) assumed burial rate of 1 mile per day

3. Wind Erosion from Exposed Areas

1.92 tons/acre/year x 7 miles(1) x 5280 ft/mile x 50 ft x 1 acre/43560 ft^2 = 81.5 tons of dust (uncontrolled)

(1) It was assumed that 7 miles of the ROW would be actively exposed at any given time and that reclamation would be done as soon as pipeline laying was completed.

(2) 50 percent of the total area was assumed to be actively exposed. This accounts for the fact that the total 100 foot ROW would not be actively exposed in most cases.

4. Gaseous Emissions from Construction Equipment

The composition of the pipeline construction fleet would be as follows (arranged in categories used in AP-42):

Tracklaying tractors	53
Wheeled dozers	11
Off-Highway trucks	65
Miscellaneous	16

In addition to these heavy-duty vehicles there would be as many as 40 light-duty, gasoline-powered vehicles traveling along the pipeline route. The emission factors from AP-42 are as follows:

Equipment Type	Emission Factor (lb/hr)				
	CO	HC	NO_2	SO_2	TSP
Tracklaying Tractors	0.386	0.110	1.47	0.137	0.112
Wheeled Dozers	0.739	0.234	5.05	0.348	0.165
Off-Highway Trucks	1.340	0.437	7.630	0.454	0.256
Miscellaneous	0.414	0.157	2.270	0.143	0.139

It was assumed that the construction fleet would operate 10 hours per day for an average of 91 days (a construction rate of 1 mile per day per spread). Emissions were calculated with the following formula:

$$E = \frac{NFT}{2000} \text{ (tons)}$$

where:

E = Pollutant emissions in tons

N = number of equipment units

F = AP-42 emission factor in pounds/hour

T = active time = 910 hours

Results are presented below:

Equipment Type	Emissions (tons) CO	HC	NO_2	SO_2	TSP
Tracklaying Tractors (53)	9.3	2.7	35	3.3	2.7
Wheeled Dozers (11)	3.7	1.2	25	1.7	0.8
Off-Highway Trucks (65)	39.6	13	226	13	8
Miscellaneous (16)	3	1.1	17	1.0	1.0
TOTAL	55.6	18.1	303	19	12.5

Light-duty, gasoline-powered vehicles would be sources of both fugitive dust and gaseous pollutants. These vehicles would be travelling to and from, and along the pipeline route. Emissions would depend on the amount of travel and would be spread out over a very large area. These temporary emissions would not be expected to have a significant influence on regional air quality.

APPENDIX A-3

OPERATIONAL EMISSIONS

During operation of the proposed project, small amounts of fugitive dust would be emitted due to wind erosion along the pipeline ROW's. Fugitive dust and gaseous pollutants would be emitted occasionally by vehicles used along the ROW's. The major emissions during project operation would be hydrocarbon emissions from the four shale oil storage tanks. These emissions were computed using AP-42 emission factors as described below.

The shale oil tanks would have double seal, floating roofs. Breathing losses can be estimated with the following equation:

$$L_S = 9.21 \times 10^{-3}(M)(P/14.7-P)^{0.7}\ (D)^{1.5}\ (Vw)^{0.7}\ (Kt)(Ks)(Kp)(Kc)$$

where:

L_S = standing storage loss = 105 lbs/day/tank = 19 tons/year/tank

M = molecular weight of material stored = 50 lb/lb-mole (assumed from AP-42)

P = pressure of material at temperature stored = 6.0 Psia, assuming ambient temperature of 85°F

D = diameter = 120 feet

Vw = average wind speed = 12.8 mph

Kt = tank factor = 0.045, from AP-42

Ks = seal factor = 1.0, from AP-42

Kc = crude oil factor = 0.84, from AP-42 (assumed equivalent to shale oil)

Kp = paint factor from AP-42 = 1.0 for grey or aluminum color

An alternate calculation of L_S is described below.

L_S = 292 lb/day/tank = 53 tons/yr assuming a mixture consisting of butanes and shale oil (vapor pressure = 11.0 psia). An extremely conservative assumption of 365 days/yr is assumed for this blend.

APPENDIX A-4

NOISE

There are currently no specific state or federal standards for outdoor noise levels. A level of 55 decibels, A-scale (dBA) is suggested as a guideline to ensure protection of public health and welfare with an adequate margin of safety in residential areas (EPA 1974).

Calculations of noise levels are based on the assumption that a noise level at 50 feet from the source (denoted by N_{50}) is reduced by 6 dB for each doubling of distance away from the source (Peterson and Gross 1972). This is a very conservative approach, since attenuation due to barriers and vegetation is not taken into account. This premise can be stated as an equation:

$$N_D = N_{50} - \frac{6\ \text{dB} \times \log_{10}\ (D/50\ \text{ft})}{\log_{10} 2} \qquad (1)$$

where N_D and N_{50} are expressed in dBA and D is distance, expressed in feet. N represents the noise level at the distance D from the noise source.

The increase of truck traffic due to pipe transport is shown in Table A.4-1. This table is similar to Table 14 of the Social and Economic Conditions Background Report. Road segments referred to in

Table A.4-1. TRUCKLOADS OF PIPE ON AFFECTED ROAD SEGMENTS FOR PROPOSED ACTION, 1984

Road Segment	Truckloads of Pipe	Number of Loads Per Day
A	852	71
B_1	852	71
B_2	852	71
C	-	-
D	-	-
E	-	-
F	1,212	101
G	720	60
H	720	60
I	306	26
J	3,540	295
K	3,684	307
L	1,656	138
M	1,656	138

Source: La Sal Pipe Line Company estimates.

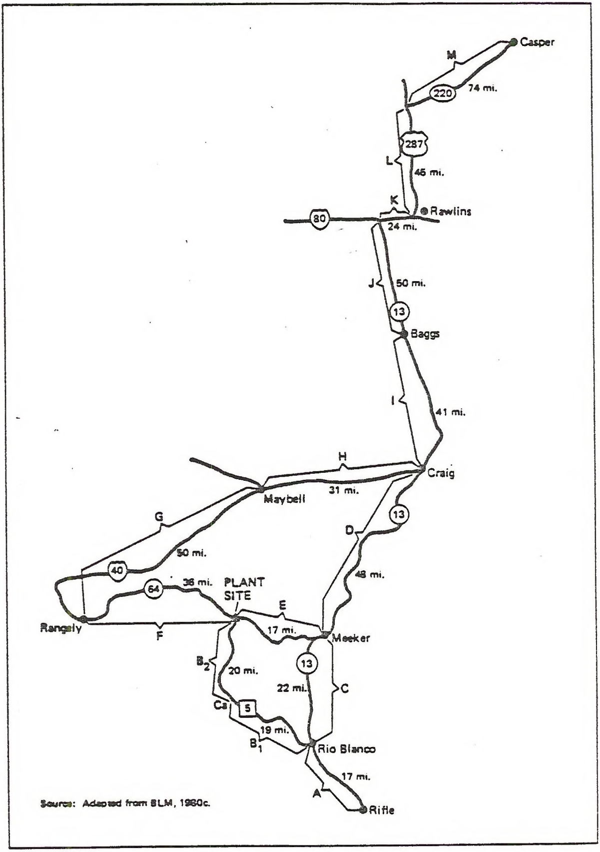

Figure A.4-1. ROAD SEGMENTS POTENTIALLY AFFECTED BY THE PROPOSED ACTION

Table A.4-1 are shown on Figure A.4-1, which is similar to Figure 1 of the above mentioned report. For each highway segment involved, truck movements would be limited to a timeframe of approximately two weeks. The number of loads per day is calculated using a six-day work week for a two week period.

Using Equation (1) and a mean sound level of 85 dBA at 50 feet for a heavy duty truck on the highway, a semi-log plot of dBA versus distance was generated (Figure A.4-2). This curve shows the attenuation of sound levels with distance, assuming no attenuation from barriers or vegetation, which would conservatively show the sound levels at various distances from the roadway in areas of open highway with level terrain. This situation would apply to the bulk of the truck traffic mileage between cities (Figure A.4-1), where residences are few and remotely located from the highway.

Truck traffic passing through the business districts and residential areas of the cities would result in more complex and severe noise impacts. However, attenuation of indoor noise levels by the structures themselves, would be expected to reduce the truck noise below the 55 dBA level. As shown on Figure A.4-2, when the same 85 dBA at 50 feet noise level impacts a structure 100 feet from the roadway, a 25 dBA structure attenuation (EPA 1978b) reduces the sound level to 54 dBA. The outdoor impacts between the roadway and city structures can be mitigated only by a reduction in the volume of traffic.

Noise impacts within city limits should be put in perspective by consideration of other noise sources. For example, automobiles have noise levels of from 60 to 90 dBA at 50 feet (EPA 1978b). Noise

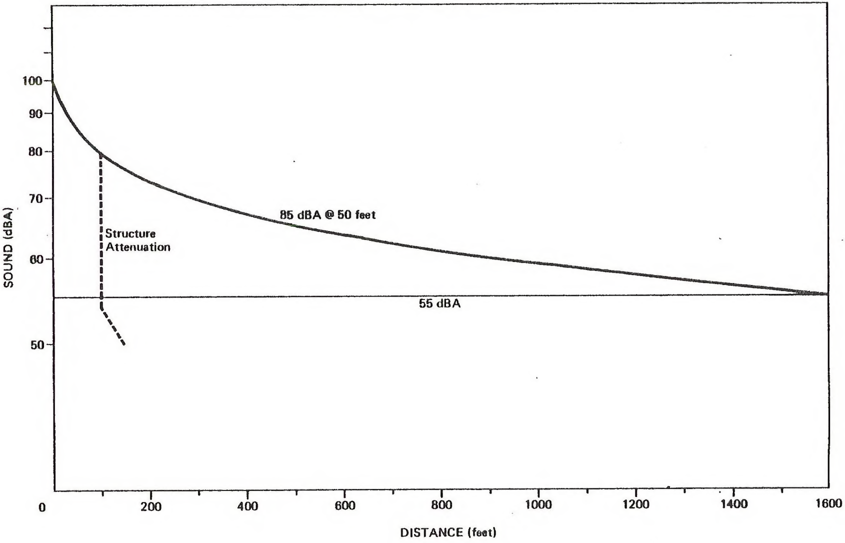

Figure A.4-2. HEAVY DUTY ON HIGHWAY TRUCK SOUND LEVEL VERSUS DISTANCE

levels are not additive, but a formula for adding noise levels from N sources is obtained from the defining equation of the decibel (N_{dB}):

$$N_{dB} = 10 \log_{10} \frac{W_1}{W_2} \quad (2)$$

where W_1 is the acoustic power, in watts, and W_2 is the reference power of 10^{-12} watt (Peterson and Gross 1972).

By manipulating the above equation, the power equivalent of N_{dB} is obtained:

$$\frac{W}{10^{-12}} = 10^{(N_{dB}/10)} \quad (3)$$

Thus, to combine noise levels, power equivalents are first summed

$$\sum_{i=1}^{n} \frac{W}{10^{-12}} = \sum_{i=1}^{n} 10^{(N_{dB_i}/10)} \quad (4)$$

then converted to the corresponding decibel value by substituting the above value in Equation 2:

$$N_{dB} = 10 \log_{10} \sum_{i=1}^{n} 10^{(N_{dB_i}/10)} \quad (5)$$

Solving equation (5) twice, once using 10 cars at 75 dBA at 50 feet and once using the same 10 cars plus one truck at 85 dBA at 50 feet results in values of 85 dBA and 88 dBA at 50 feet, respectively. Although the spatial relationships of the various noise sources and barriers cannot be modeled rigorously for a complex urban environment, these calculations demonstrate the relatively small contribution of truck traffic to the total noise levels in the city.

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LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

ENERGY USE
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL
ENERGY USE BACKGROUND REPORT

Discussion of the analysis of energy consumption by the proposed project has been divided into two categories; construction and operation. The early phase energy consumption is in the form of petroleum products (diesel fuel and gasoline) utilized as fuel for construction vehicles and equipment. The pipe manufacturing process is included in this section also. The bulk of the energy consumed during pipeline operation is used by the electric pumps. Another small source of fuel usage during the operating phase will be due to vehicular consumption for routine service and inspections. Following is the detailed estimated heat budget for the project.

CONSTRUCTION PHASE

Pipelines

Energy use is calculated for construction of the Parachute to Maybell portion of the 16-inch proposed trunkline, the Maybell to Casper portion of the 16-inch proposed trunkline, and the 12-inch Rangely lateral. Tables 1, 2 and 3 show the equipment required for one spread and the overall fuel consumption expected for the entire pipeline construction. As can be seen in these tables, the total fuel usage will be about 522,000 gallons of diesel fuel and 234,000 gallons of gasoline. As described in the emissions inventory, these figures represent conservative estimates. The average heating values for diesel and gasoline are 127,440 and 120,270 British thermal units

Table 1. PARACHUTE TO MAYBELL 16-INCH
CONSTRUCTION FUEL CONSUMPTION

Item	Number	Unit Fuel Consumption (gal/hr)	Operating Time (hr/day)	Daily Fuel Consumption (gal/day)	Working Time (days)	Total Fuel Consumption (gal)
Diesel						
D8 Dozer	3	10	9	270	71	19,170
D7 Dozer	3	8	9	216	71	15,336
D6 Dozer	1	6	9	54	81	4,374
D6 Tack Rig	2	6	9	108	59	6,372
561 Sideboom	5	4	9	180	81	14,580
571 Sideboom	3	6	10	180	66	11,880
320 Trencher	1	8	10	80	55	4,400
Backhoe	4	7	9	252	81	20,412
Hvy Duty Truck	8	14	9	1008	41	41,328
Compressor	3	8	10	240	21	5,040
					TOTAL	142,892
Gasoline						
Hvy Duty Truck	3	6	5	90	81	7,290
Welding Truck	9	5	8	360	81	29,160
Crew Bus	2	6	4	48	63	3,024
Pickup Truck	12	5	4	240	81	19,440
					TOTAL	58,914

Table 2. MAYBELL TO CASPER 16-INCH CONSTRUCTION FUEL CONSUMPTION

Item	Number	Unit Fuel Consumption (gal/hr)	Operating Time (hr/day)	Daily Fuel Consumption (gal/day)	Working Time (days)	Total Fuel Consumption (gal)
<u>Diesel</u>						
D8 Dozer	4	10	9	360	119	42,840
D7 Dozer	4	8	9	288	119	34,272
D6 Dozer	1	6	9	54	137	7,398
D6 Tack Rig	3	6	9	162	98	15,876
561 Sideboom	-	-	-	-	-	-
571 Sideboom	10	6	9	540	119	64,260
320 Trencher	2	8	10	160	94	15,040
Backhoe	3	7	9	189	137	25,893
Hvy Duty Truck	8	14	9	1,008	70	70,560
Compressor	3	8	10	240	34	8,160
					TOTAL	284,299
<u>Gasoline</u>						
Hvy Duty Truck	5	6	5	150	134	20,100
Welding Truck	12	5	8	480	137	65,760
Crew Bus	2	6	4	48	106	5,088
Pickup Truck	16	5	4	320	137	43,840
					TOTAL	134,788

Table 3. PICEANCE CREEK TO RANGELY 12-INCH
CONSTRUCTION FUEL CONSUMPTION

Item	Number	Unit Fuel Consumption (gal/hr)	Operating Time (hr/day)	Daily Fuel Consumption (gal/day)	Working Time (days)		Total Fuel Consumption (gal)
Diesel							
D8 Dozer	3	10	9	270	47		12,690
D7 Dozer	3	8	9	216	47		10,152
D6 Dozer	1	6	9	54	55		2,970
D6 Tack Rig	2	6	9	108	37		3,996
561 Sideboom	5	4	9	180	55		9,900
571 Sideboom	3	6	10	180	43		7,740
320 Trencher	1	8	10	80	25		2,000
Backhoe	4	7	9	252	55		13,860
Hvy Duty Truck	8	14	9	1,008	28		28,224
Compressor	3	8	10	240	12		2,880
						TOTAL	94,412
Gasoline							
Hvy Duty Truck	3	6	5	90	55		4,950
Welding Truck	9	5	8	360	55		19,800
Crew Bus	2	6	4	48	40		1,920
Pickup Truck	12	5	4	240	55		13,200
						TOTAL	39,870

(Btu) per gallon, respectively. Based on these figures, the conservative energy estimate indicates that the pipeline construction phase will require 9.5×10^{10} Btu, in the form of motor fuels.

Pump Stations

Construction of the pump stations and associated tankage will require a small amount of energy, relative to the amount used in the construction of the pipeline. Table 4 shows the motor fuel usage required to build the Parachute pump station. Multiplying these values by four to determine the energy used for construction of the four pump stations required to achieve the full pipeline capacity of 150,000 barrles per day (BPD) represents a conservative approach since the Parachute pump station would be the largest and most complex of the four. Pump station construction would consume a total of 2.9×10^9 Btu. This figure represents approximately 3 percent of the amount that would be expended for construction of the pipeline.

Pipe Manufacturing

The energy expended in the manufacture of the actual pipe used in the pipeline can be calculated from the average Btu cost per ton of steel pipe, 3305 Btu/pipe-ton (Colorado Energy Research Institute 1976). The expected mass of the 16-inch pipe is 52.7 lbs/ft (Towers 1981). Using 320 miles of 16-inch pipe as a conservative approach, plus 10 percent for terrain, there are 1.6×10^8 Btu consumed in the manufacturing process.

OPERATIONAL PHASE

Pipeline Requirements

The 150,000 BPD pipeline would require a total of 30,000 horsepower of pumping power distributed over four pump stations. To convert this to energy usage the factor of 2546 Btu per horsepower-hour

Table 4. PARACHUTE PUMP STATION
CONSTRUCTION FUEL CONSUMPTION

Item	Number	Unit Fuel Consumption (gal/hr)	Operating Time (hr/day)	Daily Fuel Consumption (gal/day)	Working Time (days)		Total Fuel Consumption (gal)
Diesel							
D8 Dozer	2	10	8	180	7		1,260
571 Sideboom	1	9	8	54	60		270
Compressor	3	8	10	240	28		6,720
Hvy Duty Truck	6	14	5	420	4		1,680
Mountainer	1	10	7	70	5		350
						TOTAL	13,250
Gasoline							
Welding Truck	2	6	5	60	20		1,200
Pickup Truck	12	5	2	120	75		9,000
Motor Roller	1	7	10	70	3		210
						TOTAL	10,410

is used. This results in 6.7×10^{11} Btu per year required for pumping.

Maintenance Requirements

The pipeline would be inspected regularly by light aircraft. This inspection schedule would be expected to require less than 10,000 gallons of aviation gas yearly, or 1.2×10^{9} Btu annually.

Ground based maintenance trucks would also be operated daily in the course of pump station maintenance. Occasionally, aircraft inspection would require that further ground-based inspection be performed, while a schedule of regular pipeline traversing would be done using light trucks. The sum of approximately 15,000 gallons of gasoline per year would be expected to be sufficient for all these operations. This is an additional 1.8×10^{9} Btu used annually.

SUMMARY

As shown in Table 5 a total of 2.02×10^{13} Btu would be consumed for construction and operation of the pipeline through its 30-year useful life. Only approximately 1 percent of this total represents energy consumption for purposes other than product pumping. The Btu value of the product is expected to be approximately 5.8×10^{6} Btu/Bbl. Assuming an average daily flow of 145,000 BPD, the pipeline will transport 8.4×10^{11} Btu/day or a total of 9.21×10^{15} Btu during a 30-year useful life. The ratio of energy consumed to energy transported is 2.2×10^{-3}, or in other words, the energy used in the pipeline project would amount to less than 3/10 of 1 percent of the energy that would be transported by the pipeline.

Table 5. ENERGY USE SUMMARY

Description	BTU/YR	BTU
Construction		
Pipeline - Gasoline and Diesel Fuel	-	9.5×10^{10}
Pump Station - Gasoline and Diesel Fuel	-	2.9×10^{9}
Pipe Manufacture - Misc. Energy Inputs	-	1.6×10^{8}
Operation		
Pumping - Electric pump (@150,000 BPD)	$6.7 \times 10^{11} \times 30$ years =	2.0×10^{13}
Maintenance - Gasoline and Aviation Fuel	$3.0 \times 10^{9} \times 30$ years =	9.0×10^{10}
	TOTAL	2.02×10^{13}

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LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

GEOLOGIC AND SEISMIC HAZARDS
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL

GEOLOGIC AND SEISMIC HAZARDS BACKGROUND REPORT

CRITERIA BY WHICH SIGNIFICANT IMPACTS WERE DETERMINED

Impacts are considered insignificant if the proposed action and alternatives avoid or design for hazardous conditions presently recognized or identified during construction.

Potential geologic hazards such as ground-shaking associated with historical earthquakes felt in the region of the pipeline were analyzed. Impacts were considered insignificant because pipelines and pump stations by their design and maintenance program can withstand all but the most severe of historical earthquakes as evidenced by observations after earthquakes.

AFFECTED ENVIRONMENT

Geologic Hazards

Several areas have been identified as subject to hazardous conditions. These are reflected in Table 1.

Seismic Hazards - Earthquakes and Faults. Steel pipelines and pumping stations are not very susceptible to earthquake damage, except where ground failure occurs beneath such structures. The potential

TABLE 1. PLANS FOR AREAS SUBJECT TO GEOLOGIC HAZARDS

Approximate Mileposts		Areas
PROPOSED TRUNKLINE		
3 to 7	(1)	Stability of slope before construction and stability of backfill and slope after construction at crossing of East Fork Stewart Gulch both near its junction with the middle fork and near Rio Blanco/ Garfield County line. Current snow-cover prevented a detailed examination of the slopes in these areas. If same location is unsuitable, more suitable locations appear to be available.
53 to 58	(2)	A four to five mile area southeast of Wapiti Peak requires very careful routing to avoid existing landslide materials or slopes underlain by weak rocks subject to landsliding. Rerouting in this area might be required to avoid the landslide hazards.
65 to 70	(3)	The proposed route south of Maybell would cross an area of naturally vegetated sand dunes that are relatively inactive. A route through these sand dunes would require exact routing and restoration measures to prevent reactivation of some sand dunes.
123 to 140	(4)	Crossing of relatively small but deep gullies, between Baggs and Mexicana Flats north of Baggs, may require installation of pipes designed to accommodate some future lateral erosion of these gullies. The area is alongside two existing pipelines.
200 to 215	(5)	An area of active sand dunes extends for approximately fifteen miles between highway 287/789 and Sand Creek Canyon to the north. Wind direction appears to be toward the east and northeast. The dunes appear to be underlain by relatively impermeable bedrock, and therefore a large number of low areas between dunes are occupied by ponds. Erosion of the dunes occurs whenever disturbance of the dunes by trenching or rutting from vehicles is done parallel to the wind direction.

Table 1. (continued)

Approximate Mileposts		Areas
		Sand Creek itself is being choked by the sand and meanders through Sand Creek Canyon and next to the pipeline route. Throughout the area the proposed route follows an existing pipeline route. However, site-specific plans as to depth of burial, specific locations of the pipe trench, and locations of the haul roads would be developed for the Plan of Operations for the ROW grant.
234 to 238	(6)	In the immediate area at the north end of Pathfinder Reservoir, between Sweetwater River and Fish Creek to the north, the proposed route parallels an existing pipeline. The reservoir appears to have an annual fluctuation and has elevated the ground-water table in the area. Water evaporation leaves behind deposits of salt over the land surface. The existing pipeline in the area has been recently protected from corrosion by the salty soil by cathodic protection. Cathodic protection might also be required along the proposed route along with weighting of the pipe in this area. Such measures could be developed during the final design.
SOUTHERN RANGLEY LATERAL ALTERNATIVE (AB) 31 to 35	(1)	Because of the narrowness of the valley and a meandering and steeply incised drainage, the pipeline would have to be located so as to minimize the potential for erosion and undercutting. There would also be a necessity to monitor this area until the drainage and trench backfill had revegetated and stabilized.
WHITE RIVER ALTERNATIVE (CEF) 10 to 16	(1)	Weak rocks on this alternative route <u>along Colorow Gulch from the White River to Crooked Wash</u> would require careful routing of the pipeline to minimize erosion or undercutting of slopes underlain by relatively weak rocks.

Table 1. (concluded)

Approximate Mileposts		Areas
YAMPA RIVER ALTERNATIVE (GHI) 5 to 6	(1)	In this area the GHI Alternative turns slightly toward the northeast and ascends a nearly 1000 ft high slope. The slope is steep and covered by colluvium that in some areas is unstable. A site specific plan by a geotechnical engineer will be required prior to construction. The plan may well require that the colluvium is removed from the path of the trench and spread in areas away from the trench. The resulting disturbance would be significant and might require a 400 to 500 ft wide ROW with a significant and visible scar when restored. The potential for instability would not be entirely removed by the engineer's recommendations and additional monitoring would be required.

for ground-shaking from moderate and major earthquakes along the proposed and alternate routes is low,and ground failure is not likely because much of the route traverses near-surface bedrock or gravels.

According to the United States Geological Survey 1975 Probability Map, ground-shaking at any one point along the pipeline route is expected to be less than 0.04 to 0.10 g with a 90% probability of not being exceeded within the next 50 years. The given acceleration in terms of intensity felt on the Modified Mercalli Intensity Scale is I to IV. Intensity V corresponds to shaking that awakens most people, and at Intensity VI some damage in the form of falling dishes or falling plaster is noted. Such shaking is generally not damaging to engineered structures such as pumping plants and pipelines because their design characteristics normally exceed design requirements for ground accelerations of 0.10 g.

The low level of shaking expected from naturally occurring earthquakes may be exceeded by ground-shaking from blasting operations. Such operations are conducted by permit and address the presence of nearby structures including pipelines. Again the pipeline is not expected to be affected by mining operations or other construction using blasting. Currently there is no evidence of open-pit large-scale blasting significantly close to the pipeline.

Active geologic faults along the proposed ROW have not been reported in the literature. Similarly, ground surface displacement resulting from subsidence due to oil-field operations has not been reported and was not observed during inspections of the ROW.

ENVIRONMENTAL CONSEQUENCES

No potentially significant seismic hazards were identified for the proposed action and alternatives. Currently identified geologic hazards would all be avoided by precise relocation and designed for, as described in the project description (Chapter Two of the DEIS). Therefore, no significant impacts would result from known or identified geologic hazards.

LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

<u>LIVESTOCK GRAZING</u>
<u>BACKGROUND DOCUMENTATION REPORT</u>

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL

LIVESTOCK GRAZING BACKGROUND REPORT

AFFECTED ENVIRONMENT

Amount of grazing affected by the proposed action was determined by considering all forage eliminated from the 100-foot right-of-way (ROW) for the entire length of the project. Animal unit months (AUM) were calculated using a value considered in the high range of the mean. Such values were obtained from local Bureau of Land Management (BLM) personnel.

Trunkline

Colorado. Approximately 110 miles of the proposed trunkline route lies in Colorado. Mean acreage per AUM is 14 for the Colorado portion of the proposed trunkline.

Wyoming. Approximately 170 miles of the proposed trunkline lies in Wyoming. The mean acreage per AUM through the Rawlins district is 12; through the Casper district the value is 7.5.

Pump Stations

Four pump stations are proposed. The Parachute pump station at milepost (MP) 0 would cover 10 acres. The Maybell pump station at MP 71 would cover 3 acres. The Baggs pump station at MP 116 would cover 3 acres, and the Rawlins pump station at MP 188 would also cover 3 acres.

Alternatives

Southern Rangely Lateral Alternative. The Southern Rangely Lateral Alternative would cover approximately 41.5 miles. The mean acreage value per AUM is 14 for this lateral alternative route.

Northern Rangely Lateral Alternative. The Northern Rangely Lateral Alternative would cover approximately 36.4 miles. The mean acreage value per AUM is 14 for this lateral alternative route.

White and Yampa River Trunkline Alternatives. The White River Alternative would increase the route mileage by 5 miles, and the Yampa River Alternative would increase route mileage by 2 miles.

ENVIRONMENTAL CONSEQUENCES

Trunkline

Colorado. Construction of the Colorado portion of the proposed trunkline would remove approximately 95 AUM/year until vegetation was reestablished on the ROW.

Wyoming. Construction of the Wyoming portion of the proposed trunkline would remove approximately 230 AUM/year until vegetation was reestablished on the ROW.

Pump Stations

Construction and operation of the four pump stations associated with the proposed project would eliminate grazing (AUM) at the proposed locations over the life of the project. The Parachute pump station would eliminate approximately 0.7 AUM/year. The Maybell pump station would eliminate approximately 0.22 AUM/year. The Baggs pump station would eliminate approximately 0.25 AUM/year. Approximately

0.40 AUM/year would be eliminated at the Rawlins pump station location.

Alternatives

Southern Rangely Lateral Alternative. Construction of the Southern Rangely Lateral Alternative would remove approximately 36 AUM/year until vegetation was reestablished on the ROW.

Northern Rangely Lateral Alternative. Construction of this lateral alternative would remove approximately 32 AUM/year until vegetation was reestablished on the ROW.

White and Yampa River Trunkline Alternatives. Construction of the White River Alternative would increase the route mileage by 5 miles and increase the eliminated AUM/year by 5 until vegetation was reestablished on the ROW. Construction of the Yampa River Alternative would increase route mileage by 2 miles and increase the eliminated AUM/year by 2 until vegetation was reestablished.

Summary

The proposed project is not anticipated to have a significant negative effect on grazing in the areas potentially affected by the proposed trunkline, Rangely lateral alternatives, or White or Yampa River alternatives. Application of evaluation criteria to other vegetation resulted in a finding of no significant impacts; i.e., less than 1 percent of the resource within the 20 mile corridor would be affected.

Compensation to proprietors of hay crops in an occasional field lost to construction would cover lost revenues or replacement values. In addition loss would be of a single crop, not the resource. For

these reasons no significant impact on these occasional hayfields is anticipated.

The number of AUM lost along the proposed trunkline is not particularly large, as the natural vegetation is not very productive. Additionally, the linear nature of the proposed action causes slight effects to any one resource utilizer.

Effects of the proposed action are also considered short-term; perennial grasses should become established within three years of initial disturbance. Range productivity is anticipated to improve as the result of specific reseeding in comparison to its current state. Areas occupied by the pump stations would be lost to grazing for the life of the project. Number of AUMs lost is minor, less than 2 AUM/year total for all pump stations. The Southern Rangely Lateral Alternative crosses five or six livestock allotments. Gates would have to be used during pipeline construction to keep wild horses off certain allotments. Integrity of range improvements would have to be reestablished; e.g., pipelines to watering troughs disturbed by construction would be returned to their original condition.

LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

MINERALS
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL
MINERALS BACKGROUND REPORT

COAL

Trunkline

Coal beds of economic interest occur in three regions along the proposed trunkline route (Table 1); the Uinta Region, the Green River Coal Region and the Wind River Coal Basin.

The proposed trunkline originates in the northern portion of the Uinta Region in Colorado. The coal occurs in the Mesaverde Group of Upper Cretaceous age. The route initially crosses deposits of high-volatile B and C bituminous coal in the eastern Piceance Creek Basin and then cuts across the western edge of the Danforth Hills Field further north. Approximately 3000 feet or more of overburden is present in this area.

The Green River Coal Region covers an extensive area in Moffat and Jackson Counties, Colorado and Sweetwater, Carbon and Natrona Counties, Wyoming. The proposed trunkline does not cross any specific coal fields in the Green River Region. The proposed trunkline passes east of Sand Wash Basin and west of the Yampa Field. The area is underlain by high-volatile B and C bituminous coal and B and C sub-bituminous coal. The coal bearing strata are the Upper Cretaceous Lance, Mesaverde and Frontier Formations and the Tertiary Fort Union and Wasatch Formations. There are some localized areas of anthracite

Table 1. COAL DEPOSITS ALONG THE PROPOSED TRUNKLINE AND ALTERNATIVE ROUTES

Approximate Milepost	Coal Region	Coal Field	Type of Coal Deposit
PROPOSED TRUNKLINE			
0-45	Uinta Region	Eastern Piceance Creek Basin	Bituminous
45-59	Uinta Region	Western Danforth Hills Field	Bituminous
73-192	Green River Coal Region	—	Bituminous and subbituminous with some localized anthracite and semianthracite
253-263	Wind River Coal Basin	—	Subbituminous
SOUTHERN RANGELY LATERAL ALTERNATIVE			
0-32	Uinta Region	Piceance Creek Basin	Bituminous
NORTHERN RANGELY LATERAL ALTERNATIVE			
0-25	Uinta Region	Piceance Creek Basin Lower White River Field	Bituminous
WHITE RIVER ALTERNATIVE			
0-16	Uinta Region	Piceance Creek Basin Western Danforth Hills Field	Bituminous
YAMPA RIVER ALTERNATIVE			
25-38.4	Green River Coal Region	—	Bituminous and Subbituminous with some localized anthracite and semianthracite

and semianthracite deposits along the route (Table 1). Abandoned strip and underground mines are near the proposed trunkline route in the Green River Coal Basin.

The proposed trunkline later crosses the southeastern top of the Wind River Coal Basin in Wyoming (Table 1). This area is underlain by subbituminous coal with less than 3000 feet of overburden. The Wind River Coal Basin is generally comprised of the same Tertiary and Upper Cretaceous formations as mentioned above for the Green River Region.

<u>Rangely Lateral Alternatives</u>

The lateral alternative routes to Rangely, Colorado also cross the coal deposits of the Piceance Creek Basin and enter the Lower White River Field east of Rangely (Table 1). The overburden decreases to less than 3000 feet in a westerly direction. The Lower White River Coal Field is also comprised of Upper Cretaceous high-volatile B and C bituminous coal contained in the Mesaverde Group.

<u>White River Alternative</u>

The White River Alternative crosses bituminous coal beds in the northern portion of the Uinta Region (Table 1). These are the same coal deposits previously described for the proposed trunkline.

<u>Yampa River Alternative</u>

The Yampa River Alternative crosses coal beds in the Green River Coal Region (Table 1). The discussion of the Green River Region along the proposed trunkline applies to the Yampa River Alternative as well.

OIL AND GAS

The proposed trunkline crosses both existing and abandoned oil and gas fields in Colorado and Wyoming (Table 2). The proposed

Table 2. OIL AND GAS FIELDS ALONG THE PROPOSED TRUNKLINE AND ALTERNATIVE ROUTES

Approximate Milepost	Type of Field	Field Name (if any) or Location	Producing Formation Age(s)
PROPOSED TRUNKLINE			
17-22	Gas	Piceance Creek Basin	Tertiary
37-41	Gas	Northeastern Piceance Creek Basin	Late Cretaceous Tertiary
109-114	Gas	Eastern portion of Washakie Basin	Late Cretaceous Tertiary
208	Gas	Abandoned (near Ferris, WY)	Late Cretaceous
209	Oil	Abandoned (near Ferris, WY)	Jurassic Triassic
212	Gas	Abandoned (near Ferris, WY)	Late Cretaceous
SOUTHERN RANGELY LATERAL ALTERNATIVE			
32-41.45	Oil	Rangely Oil Field	Late Cretaceous Jurassic Triassic Permian Pennsylvanian
NORTHERN RANGELY LATERAL ALTERNATIVE			
0-5	Gas	Northeastern Piceance Creek Basin	Late Cretaceous Tertiary
25-35	Oil	Rangely Oil Field	Late Cretaceous Jurassic Triassic Permian Pennsylvanian
WHITE RIVER ALTERNATIVE			
0-10	Gas	Northeastern Piceance Creek Basin	Late Cretaceous Tertiary

trunkline crosses oil and gas fields in the Piceance Creek Basin, Colorado, the Washakie Basin, Wyoming and the Sweetwater Uplift, Wyoming.

The producing formations range in age from Permian to Tertiary. The oil and gas fields along the proposed trunkline are generally structural traps in the Piceance Creek Basin, Axial Basin and the Sand Wash Basin. The potential for future exploration and production in these areas exists due to the complex structure and the very thick sedimentary deposits.

Rangely Lateral Alternatives

Both of the lateral alternative routes to Rangely, Colorado terminate in the Rangely Oil Field (Table 2). Some of the gas fields along or near these lateral alternatives are abandoned or used for secondary purposes including waterflood projects.

White River Alternative

The White River Alternative crosses through a natural gas field in the northeastern Piceance Creek Basin (Table 2). The producing formations are of Late Cretaceous and Tertiary age. This field is the same field the proposed trunkline crosses in the Piceance Creek Basin.

URANIUM

Trunkline

The proposed trunkline crosses near but not through two named uranium mining districts; Maybell, Colorado and Baggs, Wyoming (Table 3).

The Maybell uranium mining district is east of Maybell, Colorado. The ore is found as disseminated uranium minerals in tuffaceous sandstones of the Miocene aged Browns Park Formation. Localized ore

Table 3. OTHER MINERAL OCCURRENCES ALONG THE PROPOSED TRUNKLINE AND ALTERNATIVE ROUTES

Approximate Milepost	Mineral	Comments	Formation(s)
PROPOSED TRUNKLINE			
0-35	Oil shale	Yielding 25 gallons or more of oil per ton	Green River
70-75	Uranium	Maybell uranium mining district	Browns Park
92-93 98-99 100-101	Gold	Areas of widespread gold-bearing rocks; no existing or abandoned mines	
208	Silica sand	Close to trunkline route	Quaternary sands
235 253-261 265	Uranium	Uranium occurrences; proposed mines	Wind River, Fort Union, Frontier, Lance, Wasatch, Mesaverde
263-264 269-274	Bentonite	Crosses bentonite bearing strata but not near any existing or abandoned bentonite mines	Mowry, Thermopolis, Frontier
SOUTHERN RANGELY LATERAL ALTERNATIVE			
0-27	Oil shale	Yielding 25 gallons or more of oil per ton	Green River
YAMPA RIVER ALTERNATIVE			
20-26	Uranium	Maybell uranium mining district	Browns Park

deposits also occur along faults. The major uranium deposits are located on the northern limb of the Axial Basin Uplift.

The proposed trunkline is east of the Baggs uranium mining district.

The proposed trunkline does cross an area of known uranium occurrences at the southeastern tip of the Sweetwater Uplift in Natrona County, Wyoming (Table 3). The route passes near some proposed uranium mines. The uranium in this area is not limited to any specific formation. Uranium is found here in almost every geological formation. Uranium bearing formations include the Cretaceous Frontier, Mesaverde and Lance Formations, the Tertiary Wind River, Fort Union and Wasatch Formations; and Precambrian plutonic and metamorphic rocks.

Yampa River Alternative

The Yampa River Alternative crosses near the Maybell uranium mining district as discussed above for the proposed trunkline (Table 3).

OIL SHALE

Trunkline

The proposed trunkline route overlies rich oil shale deposits in the Piceance Creek Basin, Colorado (Table 3). The oil shale is found in the middle Eocene lacustrine deposits of the Green River Formation. The oil shale deposits reach a maximum thickness of 2000 feet in the Piceance Creek Basin and yield 25 gallons or greater of oil per ton.

Southern Rangely Lateral Alternative

The Southern Rangely Lateral Alternative crosses the same oil shale deposits of the Piceance Creek Basin described above (Table 3).

GOLD

The proposed trunkline crosses three areas of widespread distribution and or numerous occurrences of gold bearing rocks in northern Moffat County, Colorado (Table 3). The area is not a designated gold mining district nor are there any active mines in the area.

BENTONITE

The proposed trunkline crosses two areas of bentonite bearing strata west of Casper, Wyoming (Table 3). The bentonite occurs in the Cretaceous Mowry, Thermopolis and Frontier Formations. The route is not near any existing or abandoned bentonite mines.

SILICA SAND

The proposed trunkline is near but does not cross an area of silica sand occurrence (Table 3). The silica sand is found in Quaternary sand deposits. The pipeline crosses Quanternary sands and the potential for additional sources of silica sands exists.

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LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

OIL SPILL ANALYSIS
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
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LA SAL PIPELINE PROPOSAL
OIL SPILL ANALYSIS
BACKGROUND REPORT

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LA SAL PIPELINE PROPOSAL
OIL SPILL ANALYSIS
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AFFECTED ENVIRONMENT

Spill Accident Analyses

Introduction. Parameters needed to evaluate the possible impacts of accidental pipeline discharges to the environment include pipeline spill frequencies, spill volumes, and rates of discharge. This section discusses sources and causes, historical spills, and predicted spill frequencies and volumes.

Accident statistics are available for operating pipelines in the United States from the U.S. Department of Transportation, Office of Pipeline Safety Operations (OPSO). The following accident analysis is derived from these statistics.

Sources and Causes. From 1968 to 1976 (1976 being the latest year for which official statistics were published), the annual number of liquid pipeline accidents has decreased markedly. The trends in the categories of pipeline accidents can be seen in Table 1. More important than the total number of accidents for each cause is the percent of the total, which is independent of the fluctuating number of pipeline miles in operation.

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Table 1. LIQUIDS PIPELINES - YEARLY ACCIDENT SUMMARY (ALL ACCIDENTS), 1968-1976

Cause	Number of Accidents									Percentage of Total								
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1968	1969	1970	1971	1972	1973	1974	1975	1976
Corrosion	232	172	179	124	100	86	67	72	51	46.5	42.7	51.5	40.2	32.5	31.7	26.2	28.3	24.4
Equipment Rupturing Line	98	90	70	67	69	66	78	73	67	19.7	22.4	20.2	21.8	22.3	24.2	30.5	28.6	32.0
Defective Pipe	36	35	32	31	32	21	20	15	14	7.2	8.7	9.2	10.1	10.4	7.6	7.8	5.9	6.7
Defective Welds	4	3	3	3	5	5	4	5	4	.8	.7	.9	1.0	1.6	1.7	1.6	2.0	1.9
Incorrect Operations	14	13	13	22	22	16	28	22	20	2.8	3.2	3.8	7.1	7.1	6.0	10.8	8.6	9.6
Other	115	80	50	61	81	79	59	68	53	23	22.3	14.4	19.8	26.1	28.8	23.1	26.6	25.4
Total:	499	403	347	308	309	273	256	255	209									

Source: U.S. Department of Transportation, Office of Pipeline Safety Operations.

Note: Yearly accident numbers include all pipeline facilities, including line pipe.

Equipment rupturing the pipeline has replaced corrosion as the major cause of pipeline accidents. Corrosion-induced spills have steadily decreased since 1969, probably as a result of federal regulations requiring that cathodic protection systems be installed on all coated pipelines by March 31, 1973.

Since the La Sal pipeline will be cathodically protected, it would be most accurate to utilize accident data for similarly protected pipelines. However, since data pertaining to total miles of corrosion-protected versus non-protected pipelines are not available from the OPSO, the accident analysis must consider all pipeline types.

The problems associated with the quality of new pipe and its installation, as shown in the above data, are small in number relative to other categories.

The percentage of the total accidents caused by incorrect operation by pipeline carrier personnel has steadily increased since 1968, as have accidents due to vandalism, weather, and equipment failure, all of which are included under the "other" causes category.

<u>Predicted Spill Frequency</u>. Accurate spill frequency predictions are difficult to assess for new installations due to the nature of the available data base. As discussed previously, the data base includes all operating liquid pipelines regardless of age or construction methods used, if any, to minimize spills. Therefore, those spill frequency predictions made in this report should be considered to be somewhat conservative.

Simple calculations of spill frequencies in the form of total accidents expected per mile of pipeline per year can be made by dividing the number of accidents in a given year by the number of existing

pipeline miles in operation. Utilization of several years of data will give a more representative number of spills. Table 2 lists the spill frequencies for all liquid pipelines for the years 1968-1975. From this analysis it can be seen that the spill frequency rate has decreased by over 50 percent during this period even though the total mileage of pipeline in operation has increased slightly. This can be attributed to older pipelines, being taken out of service and the increasing use of cathodic protection systems and coated pipe to inhibit corrosion, one of the leading causes of pipeline leaks.

When the annual accident-per-mile data versus the yearly data from Table 2 are fitted to a power law equation, the trend in accidents per mile is easily seen. This trend would indicate that annual rates on the order of 0.001 accidents per mile of pipeline will be the norm for the mid-1980s. Because the La Sal pipeline will be new, it is expected that it will not have any greater yearly accident rate than the predicted national annual rate of 0.001 per mile. Therefore, using the national average for all pipelines and approximately 314 to 320 miles of pipeline in the La Sal case, the average leak frequency would be on the order of one leak every three years for the system. In interpreting this number, one must keep in mind that the La Sal system will be new and will be utilizing state-of-the-art technology and should be in a position to operate at less than this frequency.

Predicted Spill Magnitudes. Spill magnitude predictions involving the La Sal pipeline are based primarily on the total throughput of the system.

Studies by Beyer and Painter (1977) and others have indicated that pipeline spill magnitudes are more closely related to the total throughput of the pipeline than the quantity spilled versus number of accidents in a given year or set of years. Utilizing this approach,

Table 2. REPORTED LINE-PIPE ACCIDENTS: ALL CAUSES - ALL PRODUCTS

Year	Reported Number of Accidents[a]	Reported Number of Trunk Pipeline Miles	Accidents Per Mile
1968	421	115,238	.0037
1969	350	117,983	.0030
1970	288	122,365	.0024
1971	258	122,471	.0021
1972	235	124,458	.0019
1973	194	122,354	.0016
1974	199	126,211	.0016
1975	180	121,278	.0015
1976	169	b	b

Source: National Transportation Safety Board 1978.

[a] Note that these figures are for line pipe only and do not include pump station or related facilities accidents.

[b] Data not yet available from ICC Part 6 Report.

Beyer and Painter have developed the following formula for determining spill magnitudes.

$$Qy = 3.6 \times 10^{-6} MMB$$

where: Qy = Barrels spilled
MMB = Throughput in millions of barrels

Using the projected throughput of 54.75 MMB per year at 150,000 barrels per day, the predicted total magnitude of spills in a given year is approximately 200 barrels. Carrying it one step further and using the predicted spill frequency of 0.3 spill per year, the average spill size is expected to be 60 barrels.

Maximum Credible Spill Size. An operational event involving maximum spillage would require total severing of the pipeline. Although highly improbable, such an event could occur as a result of accidental damage during excavation near the alignment, improper operation, stream washouts, or sabotage. The pipeline system has been designed to minimize such losses through leak detection instrumentation, remotely operating pump shutdown equipment, strategically located check valves, manual block valves, and remotely operated valves. The maximum credible spill size at any point in the line is therefore a function of the pumping loss incurred during the time between leak detection and actual shutdown and the volume of oil that can drain from the line before and after automatic and manual valves are closed.

Five scenarios have been evaluated to illustrate typical maximum credible spill losses. The sites of the spills are in the Piceance Creek area (milepost [MP] 16.3), at the White River crossing (MP 37.2), at the Yampa River crossing (MP 71.0), at the alternative Yampa River crossing (alternative MP 22.7), and at the Sweetwater River

crossing above the Pathfinder Reservoir (MP 235.0). For each scenario the following assumptions have been made:

- After instrumental leak detection, 2 minutes will be required to react and terminate pumping.
- Under the influence of gravity alone, approximately 1/4 mile of pipe will drain every 60 minutes.
- The average time required to travel to and shut remote manual block valves will be approximately 4 hours.
- Where block and check valve locations were not established, they were assumed to be located at points having existing vehicular access.

Based on these assumptions the maximum credible spill sizes for each scenario have been calculated (see Table 3).

In actual practice the predicted spill sizes could be further reduced through evacuation of sections of the pipeline below the break by continued pumping and through shorter response times.

<u>Product Composition</u>. The proposed La Sal pipeline would transport a synthetic crude oil (syncrude) to be derived from oil shale. Table 4 presents the composition and properties of the La Sal syncrude product. The API gravity of 44.5, which corresponds to a specific gravity of 0.804, indicates a light to very light oil. This syncrude would have a relatively high percent paraffins (waxes), relatively high pour point, and relatively low viscosity. It would perhaps be similar to light crude oils from Libya, Nigeria or Egypt in regard to these properties. However, the specific composition of this syncrude would be unique.

Table 3. CALCULATED CREDIBLE MAXIMUM SPILL SIZES (IN BARRELS[a]) FOR SELECTED SCENARIOS

Scenario	Loss Prior to Pump Shutdown	Drainage Loss Prior to Block Valve Closure	Drainage Loss Following Block Valve Closure[b]	Total Loss (Approx.)
Piceance Creek	210	1320	1320	2850
White River	210	1320	790	2320
Yampa River	210	1320	1510	3040
Yampa River Alternative	210	1320	720	2250
Sweetwater River	210	1320	1050	2580

[a]One barrel equals 42 gallons.

[b]Pipeline volume between the block valve and check valve.

Table 4. COLONY PRODUCT OIL COMPOSITION AND PROPERTIES[1]

Composition/Properties		Naphtha	Gas Oil	Combined Product
Cutpoint Definition (°F)		C_5-400	400-925	C_5-925
Product Rates, KB/SD		17.5[2]	29.4[2]	46.9[2]
API Gravity		63.6	34.8	44.5
Sulfur, wppm		<10	<10	<10
Nitrogen, wppm		<2	750	500
Arsenic, wppm		-	-	-
Olefin Content, Vol %		-	<2.0	≤1.0
Pour Point, °F		-	-	50-60[3]
Viscosity Cp at 50°F		-	-	5[3]
RVP, psia		-	-	6.6[3]
No Vapor Pressure				
<u>Component Type Analysis</u>				
Paraffins,	Vol %	49.0	33.5	39.3
Naphthenes,	Vol %	39.2	36.5	37.5
Mono Aromatics	Vol %	10.8	25.2	19.8
Dicyclic Aromatics,	Vol %	1.0	3.5	2.6
Tri+ Aromatics,	Vol %	0	1.3	0.8
		100.0	100.0	100.0

(1) Unless noted otherwise this data was extracted from: <u>Review of ARCO Hydrotreating Technology for Colony Project</u>, September 24, 1980, Colony File 7-701, T-702.

(2) From Braun design sheets for the Colony hydrotreaters.

(3) Extracted from Colony EIS, p. II-91.

<u>Physical and Chemical Processes</u>. Following a spill, a number of physical and chemical processes could affect the oil. These could include dispersion, evaporation, dissolution/solubilization, emulsification, chemical and photooxidation, and biodegradation.

These processes, in combination with site-specific background conditions, would dictate the specific water quality alterations following a spill into or near a watercourse.

Evaporation following a spill would reduce the percentage of volatile components in the product mix, and increase the density of the residual material. Recent investigations (Nadeau and MacKay 1978) on light and medium crude oils (above the pour point) indicated that, over a 0° to 30°C temperature range, up to 25 to 50 percent of the oil may evaporate in the first few hours following the spill. Most of the hydrocarbons less than C_{15} would evaporate. Another process that might act to reduce potentially soluble fractions would be photooxidation, acting on paraffins and aromatics with suitable sidechains.

A spill into flowing streams and rivers, most of which are relatively shallow (<1 to 5 feet), would be subject to turbulent mixing. Under such circumstances, an oil-in-water emulsion (dispersion) could form, e.g., some of the oil could be dispersed as droplets within the water. In less turbulent portions of streams (side pools, eddies, etc.) or in the Pathfinder Reservoir, emulsified droplets could coalesce, and re-form as a light surface film. Under most circumstances ambient water temperatures will be below the pour point of the material. Under such temperature constraints, the oil will behave as a solid, greatly reducing the tendency to emulsify.

A certain fraction of the oil would be soluble in the water column. Specific compounds that would solubilize, and their

concentration, would be highly site-specific depending upon ambient temperature, conductivity, pH, hardness and other factors. For a spill at low background temperature, solubility and evaporation would be very low. Concentrations of dissolved constituents would further change as a result of dilution and dispersion in the water column and via acidbase reactions, complex formation and other processes. The soluble constituents with carbon chains less than C_{12} to C_{15} would evaporate within 24 hours.

Water Quality Effects. Water quality characteristics at selected streams and crossings are provided in Table 5. A small fraction of the La Sal syncrude would be water soluble. The available data base for freshwater solubility of crude oil is limited; for shale syncrude, it is even more sparse. Winters and Parker (1977) investigated the freshwater solubility of four typical crudes (Kuwait, Venezuelan, Southern Louisiana, and Alaskan). Constituents that were found to be soluble were alkyl benzenes, phenols, naphthalenes, tetralins and indans. Constituents soluble in low or trace concentrations included biphenyls and benzothiophes. Some characteristic solubilities of a light crude oil in water were reported by Nelson-Smith (1973) and are shown in Table 6. Most of the soluble paraffins shown would evaporate. Jones et al. (1976) investigated a synthetic shale oil, demonstrating the solubility of alkyl benzenes, naphthalenes and phenols.

It is likely, therefore, that the most soluble monoaromatic would be alkyl benzenes. The diaromatic naphthalenes would be only slightly soluble. Mono-, di- and triaromatic phenols would be fairly soluble due to the functional hydroxl group.

Entrainment of suspended sediments on surface film or emulsified oil (along with evaporation) would increase the density of the syncrude. It is conceivable, given the fairly high natural levels of

Table 5. WATER QUALITY CHARACTERISTICS AT STREAM AND RIVER CROSSINGS

Stream or River	Gaging Station No.	Temperature (°C)			Dissolved Oxygen (mg/l)			Suspended Solids (mg/l)		
		Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
Stewart Gulch (mouth)	09306028	-	0.0	-	-	-	10.5	2,590	97	460
Piceance Creek (Rio Blanco)	09306007	25.0	0.0	9.5	-	6.2	-	6,500	100	1530
Piceance Creek (White River)	09306	30.0	0.0	9.1	16.2	4.9	9.7	5,300	401	1610
White River (Piceance)	000117	25.6	0.0	7.7	-	1.1	11.7	91,500	0	1200
White River (Rangely)	09306300	29.0	0.0	10.9	13.4	5.8	9.3	43,400	17	2400
Poison Spider	06643900	28.7	0.0	9.4	14.6	6.7	10.3	4,080	1040	1490
Path Finder Reservoir (Sweetwater Arm)	06639600	20.0	13.5	16.6	10.0	3.2	6.7	350	290	310
Sweetwater River	06639000	27.2	0.0	8.3	12.4	6.3	9.7	240	4	41
Yampa River (Maybell)	000039	24.4	0.0	7.9	15.0	7.8	10.6	575	55	310

Source: U.S. EPA STORET Inventory 1981.

Table 6. SELECTED CHARACTERISTICS OF HYDROCARBONS IN CRUDE OIL

Compound	Carbon Number	Boiling Point (°C)	Melting Point (°C)	Density (SG)	Solubility in Water	Presence in Oklahoma crude (% vol)
PARAFFINS						
Methane	1	-161.5		0.424	90 ml/l (20°C)	
Ethane	2	- 88.5		0.546	47 ml/l (20°C)	
Propane	3	- 42.2		0.542	65 ml/l (18°C)	
Butane	4	- 0.5		0.579	150 ml/l (17°C)	
Pentane	5	36.2		0.626	360 ppm (17°C)	
Hexane	6	69.0		0.660	138 ppm (15.5°C)	1.8
Heptane	7	98.5		0.684	52 ppm (15.5°C)	2.3
Octane	8	125.7		0.703	15 ppm (15.5°C)	1.9
Nonane	9	150.8		0.718	c. 10 ppm	1.8
Decane	10	174.1		0.730	c. 3 ppm	1.8
Undecane	11	195.9		0.741		1.7
Dodecane	12	216.3		0.766		1.7
Tridecane	13	235.6	-5.5	0.756		1.6
Tetradecane	14	253.6	6	0.763		1.4
Pentadecane	15	270.7	10	0.769		1.2
Hexadecane (Cetane)	16	287.1	18	0.773		1.0
Heptadecane	17	302.6	22	0.778		0.9
NAPHTHENES						
Cyclopropane	3	- 33			"slight"	
Cyclobutane	4	13				
Cyclopentane	5	49.3		0.751		0.05
Methylcyclopentane	6	71.8		0.749		0.9
Cyclohexane	6	80.7		0.779		0.7
Methylcyclohexane	7	100.9		0.769		1.6
Ethylcyclopentane	7	103.5		0.763		0.2
Ethylcyclohexane	8	131.8		0.788		0.4
Trimethylcyclohexane	9	141.2		0.777		0.2
AROMATICS						
Benzene	6	80.1		0.879	820 ppm (22°C)	0.2
Toluene	7	110.6		0.866	470 ppm (16°C)	0.5
Ethylbenzene	8	136.2		0.867	140 ppm (15°C)	0.2
p-Xylene	8	138.4		0.861		0.1
m-Xylene	8	139.1		0.864	c. 80 ppm	0.5
O-Xylene	8	144.4		0.874		0.3
iso-Propylbenzene (Cumene)	9	152.4		0.864		0.07
n-Propylbenzene	9	159.2		0.862	60 ppm (15°C)	0.09
Naphthalene	10	217.9	80.2	1.145	c. 20 ppm	0.06
2-Methylnaphthalene	11	241.1	37	1.029		0.2
1-Methylnaphthalene	11	244.8	-22	1.029		0.1
Dimethylnaphthalene	12	262.0	-18	1.016		
Trimethylnaphthalene	13	285.0	92	1.01		
Anthracene	14	354	216	1.25		

Melting points are given mainly to indicate those substances which are solid at or near normal water temperatures. Data largely from McKee (1956); Hodgman, Weast & Selby (1960); Spidell (1941).

suspended solids shown in Table 5, that the specific gravity of the syncrude could increase to a point where a very small portion of it would sink to form bottom sediment deposits or sludge. Long-term solubilizations at the sediment/water interface could occur along with biological degradation. The amount likely to sink, however, would be a very small percentage of the total.

The formation of surface films would limit or reduce the available reaeration rate. Microbial decomposition of the oil could further reduce available oxygen due to the biochemical oxygen demand. Temporary oxygen sags could occur in quiet pools or within isolated sections of Pathfinder Reservoir. Because of the relatively high background levels of dissolved oxygen in receiving waters (Table 5), the available mixing in streams and rivers, the size of Pathfinder Reservoir, and the limited duration of surface coverage at any point, this effect would not likely be severe.

Downstream uses could be temporarily impaired following a spill. The White and Yampa rivers are both designated for municipal water supply (existing or future). Instream diversions downstream of a spill would likely be discontinued immediately following a large spill. Small or unidentifiable leaks, or larger spills prior to detection, could however impair municipal supply, especially in downstream reservoirs. The concentrations of certain toxic organics, principally phenols, would increase. This would contribute to the cumulative organic pollutant load in water supplies.

<u>Site Descriptions</u>

<u>Piceance Terrestrial Site</u>. This scenario was developed to consider a terrestrial spill. The site chosen is an irrigated hay meadow, south of Piceance Creek, MP 15.9. The site is on the upstream side of Piceance Creek (in terms of pipeline flow), negating effects of a

backflow check valve. The area is cultivated on the floodplain and is not restricted to a narrow riparian zone.

This area is underlain by recently deposited alluvium, which is limited to valley bottoms along creeks. The alluvium consists of sand, gravel, and clay that in large part originates from the sandstone and marlstone of the Uinta Formation. The thickness of the (valley) alluvium varies throughout the region and is known to reach a depth of 140 feet. Ground water may exist in both an unconfined (water-table conditions) and a confined condition depending on the presence of discontinous beds of clay- and/or silt-sized material. Depth to ground water in the alluvium will vary. Ground water will be closest to the ground surface near Piceance Creek, especially when it is flowing (i.e., either recharging the ground or being fed by ground water). Ground water will be farthest from the ground surface near the valley edges, which consist of the Green River Formation.

In the area of the spill site, no hydrogeologic information is available concerning the thickness of the alluvium and the depth to ground water. However, it is estimated that the alluvium is not more than 100 feet thick and that the depth to ground water is no more than 30 feet for the spill site.

<u>White River Crossing</u>. The White River originates in western Colorado and feeds into the Green River. The flow varies throughout the year, with average discharge of 375 cubic feet per second (cfs) from August through April. Melting snow raises this discharge to 3500 cfs in June or July. Ice cover, not always complete, generally occurs on the river from December until March. Average annual discharge is 420,000 acre feet.

The proposed trunkline crossing is located near the mouth of Piceance Creek. U.S. Geological Survey stream profiles indicate a

waterway 100' wide, 2' deep, with pools of 4'-5' during periods of low flow. The White River Alternative crossing occurs in similar conditions.

Yampa River Crossing. The Yampa River is one of the major rivers of northern Colorado; it begins in the National Forest west of Yampa, Colorado and joins the Green River in Dinosaur National Monument. Its general flow regime is similar to that of the White River, with several months of relatively low flow followed by floods from snow melt. Discharges at this time may be several times as large as the average flows. Ice cover generally occurs from December until March. The average annual discharge is 1.2 million acre feet, approximately four times that of the White River.

The proposed trunkline crossing is near the town of Maybell, Colorado. The Yampa River in this area is generally wide and shallow, with an occasional deeper pool during periods of low flow.

Pathfinder Reservoir. This scenario involves the Sweetwater River and nearby Pathfinder Reservoir. The reservoir was formed by damming of the North Platte River, flooding its canyon and those of some of its tributaries. The area of concern in this scenario is the Sweetwater arm of Pathfinder Reservoir.

ENVIRONMENTAL CONSEQUENCES

Scenarios

Piceance Terrestrial Spill.

Potential Movement of Product Oil. The flow of hydrocarbons through the ground is governed by somewhat complicated physical considerations. Hydrocarbon infiltration into the ground is a multiphase

flow problem: hydrocarbons, water and air in a porous medium. To predict the distribution and flow of a given hydrocarbon in an unsaturated soil, it is necessary to calculate the fluid potential of the hydrocarbon. Information needed to solve the governing differential equations includes:

a) Volume and area of spill.

b) Properties of the geologic medium, such as the intrinsic permeability, k, of the material.

c) Relative permeabilities of the three fluids in the medium. The permeability of a given fluid in a given medium is affected by the presence of the other fluids in the medium. Each relative permeability depends on the degree of saturation of all fluids.

d) Fluid properties of the fluids in the medium, such as densities, surface tensions (between the fluids), wetability factors (between the fluids), and viscosities.

e) Initial and boundary conditions of the system.

The governing equations for the flow of hydrocarbons in the unsaturated (3-phase flow) and saturated (2-phase flow) zone are similar to those for 2-phase and 1-phase flow in porous media. The equation representing fluid potentials is substituted into a form of Darcy's law, which is in turn substituted into an equation representing the conservation of mass.

Gravity is the main control over the downward movement of the hydrocarbon. Capillary forces have a strong control over the lateral spread of an infiltrating volume of hydrocarbons. The relative permeabilities of the fluids are very dependent on the extent of saturation

of the other fluids, and there are threshold saturations under which a fluid is immobile. (See Schville 1967 and Van Dam 1967 for a detailed discussion).

Sample Calculation. Some empirical relations have been developed to provide estimates of the behavior of hydrocarbons in soils. The maximum depth of penetration can be estimated from (Concawe 1979):

$$D = \frac{1000\ V}{A\ R\ k},$$

where D = maximum depth of penetration (m);
V = volume of infiltrating hydrocarbon (m^3);
A = area of infiltration at surface (m^2);
R = retention capacity of soil (liters/m^3);
k = approximate correction factor for various oil viscosities:
k = 0.5 for low viscosity petro products, e.g., gasoline
k = 1.0 for kerosene, gas, oil, and products with similar viscosities
k = 2 for more viscous oils such as light fuel oil.

What would be the approximate depth of penetration for our spill scenario using the above formulation? The volume of the spill is 2850 barrels or 453 m^3. If we assume the area of infiltration is initially 0.1 meter deep and circular in shape, then A = 4530 m^2 (circle with radius of 38 m). Other values chosen are R = 15 $1/m^3$ (value for coarse and medium sand) and k = 2 (value for more viscous hydrocarbons).

The approximate depth of penetration for the 2850 barrels of oil spill scenario was calculated using equation 1. The area of infiltration was specified by assuming a circular spill with an average depth of 0.1 meter. The retention capacity was assumed to be 15 $1/m^2$, value typical of coarse and medium sand, and a correction factor of 2 was assumed. Therefore:

$$D = \frac{1000\ (453\ m^3)}{(4530\ m^2)\ (15\ 1/m^3)\ (2)}$$

D = 3.3 meters (11 feet)

(This value of D holds if the water table is deeper than 3.3 meters)

The depth of penetration is not very great for the volume of spill. Note, though, that 1) if the area of infiltration is larger (smaller spill thickness), the depth of penetration becomes smaller; 2) the more viscous the oil the higher the factor k and the smaller the depth of penetration; and 3) the finer-grained the material (e.g., alluvium), the higher the R value and the smaller the depth of penetration. These observations check intuitively. Any fine-grained bed will significantly affect the downward migration of hydrocarbons and spread the hydrocarbon in a lateral direction. Empirical relations for calculating the final width of the infiltrating hydrocarbon plume and the time it takes the plume to reach maximum infiltration depth do not appear to have been developed.

The maximum spread of hydrocarbons on the water table can be estimated from (Concawe 1979):

$$S = \frac{1000V - ARdk}{F}$$

where V, A, R, and k are as described previously and

S = maximum spread of hydrocarbons on the water table (m^2)

d = depth to water table (m)

F = hydrocarbon contained immediately above capillary fringe ($1/m^2$)

Using the values of the previous problem, and assuming a depth to ground water of 1.5 meters, and an F = 12 (for coarse

sand, medium sand), typical values for the alluvial aquifer at the spill location are:

$$S = \frac{1000\ (453) - (4530)\ (15)\ (1.5)\ (2)}{12}$$

$$S = 20{,}750\ m^2$$

This value of S gives a circular area with a radius of about 80 meters. If the water table is sloping, then the hydrocarbons would migrate in the downslope direction, unless there exist areas of increased permeability in the opposite direction. The shallower the water table, the greater the spread of hydrocarbons on the water table.

The above calculations should be considered approximate. They give an idea of the order of magnitude of the ultimate distribution of hydrocarbons released to the subsurface hydrologic environment.

Another factor that is important in considering hydrocarbon infiltration is the dissolution of certain hydrocarbons in ground water. Ultimately, this results in the spread of small quantities of hydrocarbons beyond the limit of the hydrocarbon plume. This subject has not been studied adequately, and no quantitative discussions are available on the magnitude of this effect.

Finally, the more volatile hydrocarbons release vapor into the unsaturated zone. This phenomenon also has not been adequately studied.

Biological Effects. Spilled oil can have numerous effects both on the individual organisms and on communities and ecosystems. The primary effect is, of course, direct mortality due to the toxicity of

the spilled oil; many organisms are killed by direct contact with spilled oil. The most toxic fractions will usually evaporate within a day or two, so primary toxic potential is generally lost quickly. However, effects such as smothering may be present for a longer period of time and may actually be more detrimental than primary effects.

An oil spill in the terrestrial environment could kill the vegetation in the area affected by the spill. The detrimental effects would be due to complete or partial coating of aerial plant parts with oil, saturation of the soil snd subsequent toxicity to the root system, and killing of the seeds present in the soil at the time of discharge. Low growing vegetation such as annual composites and grasses would probably be more severely affected in the short term due to an oil spill, but the loss of larger shrubs and trees would create a longer-term impact. The loss of the larger shrubs and mature trees would remove a dominant component in the community and reduce habitat diversity in the affected area. This would be a long-term impact due to the slow growth of larger shrubs and trees. Furthermore, the original species may not return.

The impact of an oil spill on bird populations depends upon location, volume, and season. Birds that feed upon seeds and ground insects would be most affected. The direct impact to birds would probably be small due to their mobile nature. Also, the size of the affected area would probably be restricted and encompass only a small portion of a bird's feeding range.

The impacts of oil spills on small mammals would probably be direct and of short duration. However, information regarding habitat loss due to oil-soaked soils for these mammals is lacking. Ingestion of oil from contaminated pelage while grooming could cause mortality. Likewise, predators such as foxes and coyotes could ingest oil from contaminated prey.

Large mammals such as deer might suffer adverse effects from oil spills by eating contaminated brose, licking oil-saturated pelage, or drinking from oil-contaminated water sources. The adverse effects might result through toxic effects of the oil or interference with digestion. Dosages required to adversely affect these mammals are not known.

White River Crossing Spill.

Potential Movement of Oil. Some of the available data assembled for streams and rivers that would be crossed are shown in Table 5. Because the La Sal syncrude is characterized by a pour point of 10 to 16°C and a specific gravity of 0.804, a spill at most crossings could produce either a fluid surface film or a semisolid surface material, depending upon the receiving water temperature. At the White, Yampa, and Sweetwater river crossings, the mean temperratures are less than the minimum pour point of the La Sal syncrude. It is likely, therefore, that a spill at one of these sites would produce a dense semisolid material that would move downstream at the surface. Temperatures at these sites reach 24 to 29°C, however, and a summer spill would behave as a fluid, spreading at the surface. The temperature would also increase both the evaporation and solubilization of the oil.

Potential movement of the spilled material is probably best approximated by considering it to move at current velocities. As such the product would move downstream, constantly being reduced in quantity by physical effects discussed prior, and by deposition on stream banks on the outside of meanders. Containment of the slick is possible within several miles of the spill; by this point the soluble fraction would have been reduced to below the minimum levels causing acute reactions.

<u>Biological Effects</u>. Toxicity of petroleum hydrocarbons is due to the chemically toxic soluble components, largely the aromatic compounds. While these lightweight products are soluble and toxic, they are also very volatile and evaporate out of the water very quickly. Evaporation proceeds more rapidly in flowing waters, as the inherent turbulence mixes the water column, and as the stream splashes over rocks on riffles and rapids, and in higher-temperature waters.

A somewhat different scenario would occur if the stream were ice covered. Little work has been done on such spills in freshwater, but research on ice-covered marine bays has shown significant amounts of lightweight hydrocarbons remained under the ice canopy three weeks after an experimental spill. Sea ice is more porous than freshwater ice, and probably holds less of the hydrocarbon content than would freshwater ice. Streams usually have open areas near rocks and in swift current. Any openings in the ice canopy would allow evaporation of the hydrocarbons.

As the spilled material would be solid during winter, evaporation and solution would be very low. However, the colder water during winter would also tend to keep any dissolved hydrocarbons in the water longer. Stream dwellers would also be less active, with slowed metabolic rates during colder times, and may ingest fewer hydrocarbons. An especially severe cold period may stress the biota, however, with heavy ice covering causing lowered oxygen levels, and animals already stressed may be more vulnerable to the effects of the hydrocarbons.

The most susceptible life states are larval forms, as determined in marine species. Eggs and juveniles are more resistant to hydrocarbon exposure. This increased sensitivity of larval stages is of the magnitude of two to three times the sensitivity of adults. The general lack of larval forms in winter helps diminish the potential effects of a spill complicated by ice cover.

Plankton can be eliminated by the presence of oil; however, it is quickly replenished from upstream sources. Plankton is not a major component of the White River. Periphyton and invertebrates at the spill site may be killed by the smothering effects of the oil. Little recovery occurs after aquatic fauna have been coated with oil. Because of the low specific gravity of the oil product, the physical contact of benthos to the crude oil is minimized. Effects of soluble oil may cause greater mortality. As soon as the spill is stopped, the stream flow will constantly introduce nonpolluted water, allowing flushing and possible recovery of some animals. Periphyton and benthos will likely be eliminated at the immediate spill site and decrease downstream, with the exception of points where large amounts of oil accummulate. No effects will occur upstream of the spill site.

Juvenile and adult fish are mobile and are capable of moving away from a site of pollution, in contrast to the sessile benthos. This reaction is less successful in a linear stream than in the three-dimensional space of a reservoir. Some fishes near the spill site may escape to points upstream of the spill. Others may move downstream to areas in which the pollutant concentration has sufficiently lessened to allow survival. Depending on flow regime, individuals can move to or into the mouths of tributaries, avoiding the product oil. Mortality would be expected in fishes close to the spill site. Recovery of individuals exposed to lower quantities of pollutant in downstream reaches may occur. Larval and very young fishes lack the mobility of larger, older individuals. Mortality would be expected if a spill occured in larval habitat.

Larvae or young fish may inhabit backwaters. Such areas may become exposed to the spill. Mortality may be higher in such backwaters, since they lack the stream flow required to flush pollutants. If these backwaters are separated from the mainstream at the time of a spill, they may be protected from pollution.

Characteristics of an individual waterway influence the environmental consequences of a spill. The White River is a dynamic stream subjected to varying conditions. It is generally ice covered for part of the year, subject to low flows in late summer, and to annual floods involving a tripling of average flow. The biotic community of such streams must adapt itself to these variations. Evidence is accumulating that disturbance may play a major role in community dynamics of some systems (discussion in Gray 1980; Connell 1978; Huston 1979).

Some communities may be more inherently capable of recolonization following a spill. A spill at low flows would affect less habitat, but would likely cause high mortalities in those areas. A spill during flood would be carried further, but would be much more dispersed and diluted. Such annual flooding may mitigate potential long-term effects of a spill, as the high turbulence, turbidity, and scouring action annually modifies the stream character. Fish quickly reinvade habitat as soon as it becomes acceptable, and invertebrate drift contains the potential to reestablish benthos and periphyton.

<u>Yampa River Crossing (Proposed and Alternative) Spill</u>. Environmental consequences of these scenarios are similar to those described for the White River Crossing spill scenario, and are not repeated here.

<u>Pathfinder Reservoir Spill</u>.

<u>Potential Movement of Oil</u>. Loss of product oil at the Sweetwater River crossing might result in the oil product entering Pathfinder Reservoir. Potential movement of the oil would be with the flow of the river. Due to the ambient temperatures in the reservoir, the spill would probably maintain as a surface film. This oil might be moved across the reservoir by the frequent winds in the area.

Effects on Pathfinder Reservoir would probably be limited to the Sweetwater arm of the reservoir, due to its size, and because the relatively narrow junction with the main body of the reservoir is amenable to action checking any further spreading.

<u>Biological Effects</u>. Time of year of spill would influence environmental consequences. Fish spawning in the shallows of the reservoir may be locally eliminated by the presence of oil product, or larvae may die from the soluble fraction of the oil. In such shallows young fish are necessarily close to the surface, giving greater potential to become mixed in a slick. Benthos in these shallow areas may suffer the same problems with the soluble fractions of the oil product.

Adult fish would be expected to move away from the affected area; however, some mortality might occur among individuals.

No unique fishery exists in the Sweetwater arm of Pathfinder Reservoir. If a spill were sufficiently ill-timed to affect a year class of fish, those effects would be short term, as individuals spawned elsewhere in the reservoir would immigrate into the Sweetwater arm.

Waterfowl utilization is not heavy on the Sweetwater arm of Pathfinder Reservoir, probably at least partly due to a general lack of shore cover. Waterfowl could become coated with oil product were they to land on the surface slick. Mortality of oil-coated birds is high. If any fish are killed or weakened by the oil, predatory or scavenging birds and mammals may be exposed to the oil product.

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LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

PALEONTOLOGY
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL
PALEONTOLOGY BACKGROUND REPORT

CRITERIA FOR EVALUATION

The proposed action and alternatives were evaluated for potentially significant impacts to paleontological resources. First, all portions of the proposed route and alternative(s) crossing geological formations known to contain fossils were identified. Potential fossil localities were identified and classified on the basis of the following criteria and assumptions:

- Geological formation and/or location - The potential for finding fossils of significant value is greater in known fossil bearing formations and/or areas near a known significant fossil locality cited in literature. There is low potential for significant fossil localities in non-fossiliferous strata.

- Topographic expression - The potential for significant fossil finds increases in areas where the right-of-way (ROW) crosses moderate to steep slopes, bluffs, cliffs, and creek crossings. It is unlikely that significant localities would be found in stream beds or other areas of gentle to flat topography.

- Degree of exposure - Considering the nature of the pipeline construction project, the concern for disturbing significant

paleontological resources is limited to a depth of approximately 5 feet or less from the surface. Preconstruction evaluation is restricted to surface exposures so that the potential for identifying significant localities is higher in areas where the bedrock is exposed. Soil, talus, vegetation cover and stream bottoms indicate areas of erosion, weathering and transportation from initial depositional environments.

Based on these assumptions, localities with potential paleontological resources were classified into the following four categories:

I. Fossiliferous areas along the routes for which there are undisturbed areas elsewhere with similar fossil assemblages.

II. Localities along the routes that are very near, or cross through localities known to contain fossils of significant scientific value.

III. Localities along the routes known to contain, or with high potential for containing fossils of significant scientific value. These areas are distinguished from Category II by the lack of detailed references for the areas coupled with the potentially high sensitivity of the areas.

IV. Known or potential fossil localities of the highest sensitivity. An example of a locality of this importance would be a bluff with an entire dinosaur exposed. This type of paleontological resource is of the highest scientific value.

AFFECTED ENVIRONMENT

The above classifications and criteria were used to identify the potential for impacts to significant paleontological resources along the proposed trunkline and alternatives.

Proposed Trunkline

A total of 50.85 miles of potentially significant paleontological resources were identified along the proposed trunkline (Table 1). Of these 50.85 total miles: 38.0 miles are Class III, 10.15 miles are Class II, and 2.7 miles are Class I. No Class IV areas were identified along the proposed trunkline.

Alternatives

Southern Rangely Lateral Alternative. A total of 2.3 miles were identified as potentially significant along the Southern Rangely Lateral Alternative (Table 2). Of these, 0.5 miles were identified as Class III and the remaining 1.8 miles as Class II.

Northern Rangely Lateral Alternative. Class II areas were identified for 1.55 miles along the Northern Rangely Lateral Alternative (Table 2). No other areas of potential significance were identified.

White River Alternative. Two-tenths of a mile of Class II area were identified along the White River Alternative (Table 2). No class III or IV areas were identified.

Yampa River Alternative. A total of 2.25 miles of Class II localities were identified along the Yampa River Alternative (Table 2). No other areas of potential concern were identified.

Table 1. CLASSIFICATION OF POTENTIALLY SIGNIFICANT FOSSIL LOCATIONS ALONG THE PROPOSED TRUNKLINE

Milepost	Classification	Fossil Type	Nearby Locality Source
7 - 13	II	Vertebrates, Invertebrates (?)	
13 - 13.2	III	Vertebrates	Kihm 1981
13.6 - 13.8	III	Vertebrates	Kihm 1981
15.1 - 15.3	III	Vertebrates	Kihm 1981
15.5 - 15.55	III	Vertebrates	Kihm 1981
15.9 - 16.1	III	Vertebrates	Kihm 1981
16.45 - 16.6	III	Vertebrates	Kihm 1981
17.65 - 18.1	III	Vertebrates	Kihm 1981
17.3 - 17.55	III	Vertebrates	Kihm 1981
18.65 - 18.95	III	Vertebrates	Kihm 1981
19.5 - 19.6	II	Vertebrates (?)	
19.95 - 20.4	II	Vertebrates (?)	
34.0 - 36.7	I	Invertebrates	Kihm 1981
36.7 - 37.0	II	Invertebrates (?)	
37.5 - 37.6	II	Invertebrates (?)	
41.25 - 41.55	II	Vertebrates (?)	
41.95 - 42.05	II	Vertebrates (?)	
42.2 - 42.55	II	Vertebrates (?)	
55.4 - 56.1	II	Vertebrates (?)	
57.0 - 57.7	II	Vertebrates (?)	
84.95 - 85.05	II	Vertebrates (?)	
89.35 - 89.6	II	Vertebrates (?)	
90.15 - 90.35	II	Vertebrates (?)	
92.8 - 92.9	II	Vertebrates (?)	
95.0 - 95.1	II	Vertebrates (?)	
101.55 - 101.65	II	Vertebrates (?)	
102.0 - 102.2	II	Vertebrates (?)	
106 - 108	III	Vertebrates	University of CA, Berkeley Museum of Paleontology
111 - 141	III	Vertebrates	Unpublished
214.5 - 218.5	III	Vertebrates	Unpublished

Sources: Kihm, Allan. 1981. Personal communication with Elizabeth McReynolds, Grand Junction BLM.

University of California at Berkeley, Museum of Paleontology, specimen locality maps.

Table 2. CLASSIFICATION OF POTENTIALLY SIGNIFICANT FOSSIL LOCATIONS ALONG ALTERNATIVE PIPELINE ROUTES

Milepost	Classification	Fossil Type	Nearby Locality Source
Southern Rangely Lateral Alternative (AB)			
0.8 - 0.95	II	Vertebrates (?)	
1.4 - 1.5	II	Vertebrates (?)	
6.7 - 7.0	III	Vertebrates	Kihm 1981
7.05 - 7.15	III	Vertebrates	Kihm 1981
7.9 - 8.0	III	Vertebrates	Kihm 1981
12.95 - 13.05	II	Vertebrates (?)	
13.4 - 13.5	II	Vertebrates (?)	
16.6 - 16.65	II	Vertebrates (?)	
16.8 - 16.85	II	Vertebrates (?)	
17.35 - 17.4	II	Vertebrates (?)	
17.5 - 17.6	II	Vertebrates (?)	
22.7 - 22.9	II	Vertebrates (?)	
25.2 - 25.7	II	Vertebrates (?)	
26.45 - 26.7	II	Vertebrates (?)	
27.7 - 27.85	II	Vertebrates (?)	
Northern Rangely Lateral Alternative (DEB)			
8.3 - 8.5	II	Vertebrates (?)	
21.45 - 21.5	II	Vertebrates (?)	
24.4 - 24.65	II	Vertebrates (?)	
25.0 - 25.2	II	Vertebrates (?)	
25.4 - 25.55	II	Vertebrates (?)	
25.85 - 25.9	II	Vertebrates (?)	
26.95 - 27.1	II	Vertebrates (?)	
27.3 - 27.5	II	Vertebrates (?)	
27.7 - 27.8	II	Vertebrates (?)	
29.3 - 29.5	II	Vertebrates (?)	
White River Alternative (CEF)			
13.1 - 13.2	II	Vertebrates (?)	
14.4 - 14.5	II	Vertebrates (?)	
Yampa River Alternative (GHI)			
0.75 - 1.2	II	Vertebrates (?)	
4.9 - 5.6	II	Vertebrates (?)	
8.4 - 8.9	II	Vertebrates (?)	
9.9 - 10.5	II	Vertebrates (?)	

Source: Kihm, Allan. 1981. Personal communication with Elizabeth McReynolds, Grand Junction BLM.

Table 3. TOTAL MILES OF POTENTIALLY SIGNIFICANT FOSSILS

	I	II	III	IV	Total
Proposed Trunkline	2.7	10.15	38.0	0	50.85
Southern Rangely Lateral Alternative	0	1.8	0.5	0	2.3
Northern Rangely Lateral Alternative	0	1.55	0	0	1.55
White River Alternative	0	0.2	0	0	0.2
Yampa River Alternative	0	2.25	0	0	2.25

Table 3 summarized the total miles identified for each category of potential significance, for the proposed trunkline and each alternative.

ENVIRONMENTAL CONSEQUENCES

Some identified potentially significant fossils could be permanently damaged or destroyed during construction, maintenance or repair of the proposed action and/or alternatives.

LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

<u>RECREATION RESOURCES (NONURBAN)</u>
<u>BACKGROUND DOCUMENTATION REPORT</u>

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL
RECREATION RESOURCES (NONURBAN)
BACKGROUND REPORT

AFFECTED ENVIRONMENT

Recreation resources for this assessment include areas actually traversed by the proposed trunkline and/or alternatives and those within 5 miles of the proposed and/or alternative rights-of-way (ROWs) where the recreation experience may be affected. Also of concern are those recreation resources that could be either directly or indirectly affected by the project work force within the area of influence (towns of Rifle, Meeker, Craig, Rawlins, Casper, Baggs, Rangely, Maybell, Parachute and the six counties of Garfield, Rio Blanco, Moffat, Carbon, Sweetwater and Natrona). For purposes of this assessment, the majority of recreation resources considered are the formally designated areas managed to both preserve and further their use for play, relaxation and amusement. Other recreation areas included are the unmanaged and dispersed recreation areas (such as sites used for fishing, hunting, hiking and off-road vehicle use) within the region of influence.

Federal, state and county recreation areas are included in the inventory of recreation resources, as well as local parks and facilities (see Social and Economic Background Document for discussion of urban recreation facilities). Table 1 identifies the major nonurban public recreation areas within the total project region, and Table 2 shows the types of facilities and use for the areas with 5 miles of the proposed and/or alternative ROWs.

Table 1. MAJOR RECREATION RESOURCES IN THE STUDY AREA

	Name of Area	County/State	Acres
1.	Colorado Nat'l Monument	Mesa, CO	19,919
2.	Dinosaur Nat'l Monument	Moffat, CO	203,815
3.	Highland Reservoir State Recreation Area	Mesa, CO	633
4.	Rifle Gap/Falls State Recreation Area	Garfield, CO	2,535
5.	Vega State Recreation Land	Mesa, CO	2,730
*6.	Rio Blanco Lake State Recreation Area	Rio Blanco, CO	
7.	BLM Lands	CO	3,909,364
8.	Forest Service Lands	CO	1,478,634
*9.	Pathfinder Nat'l Reservoir	Natrona, WY	15,528 (117 shore miles)
10.	Kortes Reservoir	Carbon, WY	83 (3 mi. shoreline)
11.	Seminole State Park	Carbon, WY	20,050 (180 mi. shoreline)
12.	Devils Gate	Natrona, WY	40
*13.	Bessemer Bend	Natrona, WY	6
*14.	Independence Rock	Natrona, WY	960
15.	Fort Fred Steele	Carbon, WY	100
16.	Alcova Reservoir	Natrona, WY	2,500 (100 acres)
17.	Gray Reef Reservoir	Natrona, WY	181 (5 mi. shoreline)

*Within 5 miles of the proposed and/or alternative ROWs, areas receiving direct impacts.

Table 2. RECREATION ACTIVITIES FOR SITES WITHIN 5 MILES OF PROPOSED AND ALTERNATIVE PIPELINE ROUTES

Recreation Area	County/ State	Picnic	Drinking Water	Restrms.	Swim	Boat	Campsites	Fish	Hunt
Rio Blanco Lake State Rec.	Rio Blanco, CO	X	X	X	X		X	X	X
Dry Creek (State)/Piceance ck, Little Hills Experiment Station (Div. of Wildlife, State)	Rio Blanco, CO	X	X	X			X Primitive	X	X
Independence Rock (State)	Natrona, WY	X							
Bessemer Bend (BLM)	Natrona, WY	None Developed							
Pathfinder (WPR)	Natrona, WY	X	X	X	X	X	X	X	X

In addition to the reservoirs and managed park areas, recreation related activities (sightseeing, picnicking, fishing, swimming, boating, etc.) take place on several of the rivers and streams either crossed or within 1 mile of the proposed trunkline and/or alternatives. Among the most popular natural waterways are the White River and Yampa River; both inventoried by the former Heritage Conservation and Recreation Service, Mid-Continent Region, for further study as national protected natural, scenic and recreational rivers. Other waterways of interest for recreational purposes include the Sweetwater River in Pathfinder National Wildlife Refuge, the Little Snake River in Moffat County, Piceance Creek and Rio Blanco Lake in Rio Blanco/ Garfield counties.

The White River Resource Area includes the three BLM Planning Units (Rangely, Piceance and Meeker). The Meeker Planning Unit (P.U.), in particular, has high quality visual resources, and is a popular recreational-use area. Both the Piceance and Rangeley P.U.'s have outstanding scenery, but recreational use is usually concentrated in the autumn months during big game hunting season. Table 3 identifies the private recreation developments within the three P.U.'s along the White River and shows the percent of activity for each. This portion of the White River offers excellent recreational scenery; interesting geologic features; and is a highly valued fishing resource (particularly on the segment upstream of Meeker).

Moffat, Rio Blanco and Garfield counties in Colorado are all within the State Planning Regions number 11 (P.U.11) (Colorado SCORP, 1981-Draft). This P.U. ranks first in the state for total land area available for recreation (5,710,174 acres) and has some 5,473 acres of water. Over 98.5 percent of the recreation lands in P.U.11 are federal lands managed by BLM, (68 percent) the U.S. Forest Service, (25.9 percent), National Park Service, (3.9 percent), and Water and Power Resources. The State manages some 64,683 acres (1.1 percent of

Table 3. S.C.S. - PRIVATE RECREATION DEVELOPMENTS INVENTORY - 1974, WHITE RIVER RESOURCE AREA

Facility-Activity	Measuring Parameters For Quantity	RANGELY P.U. No. Areas	RANGELY P.U. Quantity	RANGELY P.U. % By Activity	PICEANCE P.U. No. Areas	PICEANCE P.U. Quantity	PICEANCE P.U. % By Activity	MEEKER P.U. No. Areas	MEEKER P.U. Quantity	MEEKER P.U. % By Activity	Total Quantity
Big Game Hunting	acres	8	40,827	13.0	18	92,291	29.5	54.0	179,879	57.5	312,997
Fishing	acres-ponds	4	49-17	53.8/38.9	1	3-2	3.3/5.6	14.0	39-20	42.9/55.6	91-36
Packing areas	number only	4	—		4	—		24.0	—		—
Horse Rental	no. horses	0			1	5	2.8	11.0	174	97.2	179
Trails	miles	6	77	15.4	18	161	32.2	36.0	262	52.4	500
Off-road vehicles (ORV)	acres-miles	6	37,827-75	14.3/23.4	17	90,242-164	34.0/51.3	27.0	137,314-81	51.7/25.3	265,383-320
Campgrounds	acres-sites	1	150 (25 tent & 35 camper/ trailer	38.1/38.7	0			8.0	244 (18 vehicle 14 tent)	61.9/61.3	394-155
Picnic grounds	acres-tables	0			0			4.0	47.23	100.1	47.23
Recreation Resort	guests	5	132	11.4	15	205	17.7	41.0	818	70.8	1,155
Vacation Ranch	guests	0			1	10	40.0	2.0	15	60.0	25
Shooting Range	positions	1	20		0		50.0	1.0	20	50.0	40
Archery Range	positions	1	20	90.9	0			2.0	2	9.1	22
Golfing	acres-holes	1	30-9	28.6	0			1.0	75-9	71.4	105-18
Boating	rentals	0			0			1.0	2	100.0	2
Snowmobiling areas	acres-miles	0			0			4.0	957-11	100.0	957-11
No. separate recreation developments*		11			18			59.0			88 acres tot.
& % of Total No.		12.5			20.4			67.0			

*Does not agree with Column totals as most areas provide more than one facility.

the total acreage) and county and local agencies manage the remaining areas. The region ranks fourth in recreational acres per person (50.4) but because of its high growth rate (20.4 percent in 1980) anticipates increased competition for available recreational resources in the future. The five top activities for participation in the region are bicycling, developed camping, picnicking, swimming and fishing in rank order; day-hiking on trails and nature study areas also rate high in participation. Critical recreational needs in the region include swimming, picnicking, four-wheeling (ORV), lake boating, developed camping and day-hiking (Colorado SCORP 1981 Draft pp 6-63/67).

The three counties traversed by the proposed project in Wyoming (Carbon, Natrona, Sweetwater) fall within Regions 1, 2, and 7 respectively. Carbon County has some 2,780,538 recreational acres (mostly BLM lands), 23,986 surface water acres and 827 stream miles in the recreation inventory; and has 955 developed camp sites, 200 picnic sites, 4 swimming sites, 17 historical areas, and 1 ski area. Natrona County has some 1,489,924 recreational acres (mostly BLM), 26,374 surface water acres, 99 public stream miles, 387 camping sites, 99 picnic sites, 5 swimming sites, 4 boating sites, 10 historical sites, and 1 ski area. Sweetwater County has 4,610,841 acres of recreational land, 36,617 surface water acres, 150 public stream miles, 328 camp sites, 29 picnic sites, 2 swimming sites, 5 boating sites, and 7 historical areas.

ENVIRONMENTAL CONSEQUENCES

The proposed project would directly affect very few of the recreation resources. Temporary disruption (e.g., noise, dust, disturbance to water quality and vegetation) during the construction phase of the project due to the presence of equipment and workforce could be experienced at the following sites: White, Yampa and Sweetwater River

crossings; Rio Blanco Lake and Piceance Creek in Colorado; and Independence Rock, Bessemer Bend and Pathfinder National Wildlife Refuge in Wyoming. Some overuse of campgrounds could take place during peak construction periods, and problems associated with enforcing campground limitations concerning temporary residential use of campsites could occur. None of these temporary disruptions are expected to significantly affect the quality of the recreation resource or the quality of the recreation experience.

Further, given the number of recreation resources available within travel distance of the local areas of residence, and the small number of workers, there will be no significant direct impacts resulting from the increased demand placed on resources by the project work force. It should be noted, however, that cummulative effects of increased demand on recreational resources may take place when the work force for the La Sal project is considered along with other development projects in the same geographic region.

LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

SOCIAL AND ECONOMIC CONDITIONS
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
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LA SAL PIPELINE PROPOSAL
SOCIAL AND ECONOMIC CONDITIONS
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LA SAL PIPELINE PROPOSAL
SOCIAL AND ECONOMIC CONDITIONS
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FRAMEWORK FOR ANALYSIS

The type and level of analysis appropriate to assessment of potential social and economic impacts associated with the La Sal proposed action and alternatives is largely determined by the characteristics of the proposed setting and by the characteristics of the project itself. The territory through which the proposed La Sal pipeline would pass has many frontier attributes, such as sparse population, a rural agrarian base, popular attitudes of strong independence, and a historical lack of economic diversity. Until recently, the rate of population growth has been slow, due largely to the high rate of out-migration, as young people left to seek jobs in other areas. Because of this, area residents have been receptive to growth and development, which they hoped would stablize local economies and community infrastructures (Murdock and Leistritz, 1979). Over the past decade, however, large-scale, non-renewable resource development projects have brought such rapid growth that they threaten to alter the social and economic features of the area dramatically and permanently.

Preliminary 1980 census data indicate that the town of Meeker, Colorado, grew approximately 28 percent between 1978 and 1980. Community population is expected to increase by an additional 247 percent by 1984 (CWACOG, 1980a). This qualifies it as a "boom town" by most

accepted standards (see, for example, Gilmore, 1976; Weisz, 1979, and Longbrake and Geyler, 1979). Many of the towns potentially affected by the La Sal project are in similar situations, attempting to accommodate rapid growth now, and anticipating even further accelerations of the growth rate over the next decade, as new coal and oil shale developments occur.

In many communities, facilities and services are at capacity. Planners at various levels of government are working to prepare for the impacts of additional announced projects that could double the population of the four counties included in the Colorado West Area by 1985 (CWACOG, 1980a). Against this backdrop, it is evident that the needs of even a relatively small project can increase the severity of existing problems. Incremental workforce and service demands, which ordinarily could be accommodated easily by a small stable town, might be impossible to accommodate in a situation of rapid social and economic change, in which virtually no excess capacity exists in community facilities and services. Therefore, evaluation of the cumulative impacts of other proposed developments on social and economic systems in the study area becomes very important in the La Sal Environmental Impact Statement (EIS).

The nature of the La Sal proposed action helped determine which social and economic issues warranted detailed analysis in the EIS, and which did not. Elements of the project description are discussed below with regard to how they delimit three aspects of potential impact: magnitude (what social and economic units are affected), duration (how long they are affected), and intensity (to what degree they are affected).

Magnitude

For the construction phase, the magnitude of potential project impacts is determined by three aspects of the proposed action:

- The 100 foot right-of-way (ROW) would extend over approximately 3,806-3,878 acres of public and private land in six counties in northwestern Colorado and southcentral Wyoming.

- Nine communities are within commuting distance of the proposed action and are of sufficient size that they could be considered as potential sources of labor, supplies, or services

- The proposed action would pass within 5 miles of several communities.

From the above information, it is possible to define the social and economic units and some of the issues assessed for potential impacts. This analysis reviews social and economic conditions in the six affected counties: Garfield, Rio Blanco and Moffat in Colorado; and Carbon, Sweetwater and Natrona in Wyoming. The communities of Parachute, Rifle, Rangely, Meeker, Craig, Maybell, Baggs, Rawlins and Casper are evaluated as potential sources of services during the construction phase. The "nuisance factor" associated with construction activity within 5 miles of existing communities is also addressed.

The magnitude of potential impacts during the operations phase is limited by the operation workforce size and location. The proposed operation workforce would consist of 35 workers. Twenty-five of these would locate at Meeker, and the other ten would be scattered in various locations along the pipeline route. It is assumed that the impact of one or two families moving into any community near the pipeline

route would be negligible, so that analysis of potential social and economic effects during operation is limited to the town of Meeker.

Duration

Duration of impacts during the construction phase is determined by the speed of pipeline construction. The estimated average speed of pipeline construction is 0.8 miles per day in the rough terrain of northwestern Colorado, and 1.5 miles per day for the Wyoming section. Assuming six ten-hour work days per week, construction crews would move at an average rate of 4.8 miles per week through Colorado, and 9 miles per week through Wyoming. At this rate, it is likely that a construction crew would not be located in any one town for more than a few weeks. The pipeline would be built in four spreads, with construction times estimated as follows:

Spread No. 1 - Parachute Pump Station to Maybell - 4 months
Spread No. 2 - Piceance Creek to Rangely - 2.5 months
Spread No. 3 - Maybell to Ferris - 3 months
Spread No. 4 - Ferris to Casper - 3 months

Construction crews would work simultaneously. It is safe to estimate that construction of the La Sal pipeline would probably commence and finish between June and November, 1984. This allows ample time for accommodating schedule changes in critical wildlife areas, as well as unforeseen problems with weather, terrain, etc.

Pipeline operation workers would live in the vicinity of the pipeline ROW for the life of the project, which could last 30 years or more. Their potential impact on the social and economic setting, however, would be limited to the time of their initial settling in the area. It is at that time that their incremental demands on community facilities and services would be accommodated.

Intensity

During the construction phase, the potential intensity of social and economic impacts is determined by the level of project and workforce needs that would have to be met locally. This in turn is determined largely by whether or not workers hired for the project are local or non-local. Locally-hired workers would create almost no change in the existing social and economic structures, while non-local workers would bring with them new demands for temporary housing, transportation, food, recreation and other services. In this analysis, the "worst case" is assumed, i.e. that construction workers will be non-local.

As mentioned above, the La Sal pipeline would be built using four construction spreads. The two Colorado spreads would have approximately 100 workers, and the two Wyoming spreads would have approximately 132 workers. The intensity of impacts resulting from the presence of workers in any one town could be reduced, as workers tend to spread out along the route during construction. For example, workers responsible for clearing and grading may move ahead of pipefitters and welders, who may move ahead of reclamation workers. Consequently, crews may actually divide and seek accommodations in different towns. For the purposes of the EIS, the "worst-case" is assessed, i.e. it is assumed that all non-local workers on a spread would seek facilities and services in the same towns at the same time.

The 35 operation workers would be specialized, skilled pipeline control center operators and maintenance personnel. Some could be trained locally, but most would probably be non-local people, 25 of whom would settle in Meeker (with dependents, if any) in 1985 or 1986. Their needs would be for a variety of local facilities and services, including housing, education, health care, recreation, etc. Their

presence could influence local income levels and local business receipts, and could induce a small amount of indirect population growth. Their accommodation in Meeker could result in some costs to the county or school district for expansion of services and facilities. On the other hand, county revenues in all six affected counties would increase once the pipeline is in operation.

Social and economic issues identified as relevant for inclusion in the La Sal impact assessment, based on the characteristics of the setting and of the proposed action, are summarized in Table 1. Data were collected and analyzed for these issues. Any potentially significant impacts identified are described in the EIS, to a level of detail reflective of their degree of potential significance.

For the purposes of impact assessment, certain "threshold" figures were selected to determine whether or not a projected impact would be significant or not significant. These thresholds are not treated as sacrosanct, but are useful as conservative indicators of possible qualitative changes in the affected social and economic systems. Social and economic impacts associated with the La Sal proposed action and alternatives were considered significant if they would bring about the following changes:

<u>Construction</u>

- employment demand on the local workforce greater than 15 percent
- temporary change in local business receipts greater than 15 percent
- demand for temporary housing and other community services that would exceed surplus capacities

Table 1. SUMMARY OF RELEVANT SOCIAL AND ECONOMIC ISSUES FOR DETAILED ANALYSIS IN BLM/LA SAL EIS.

	CONSTRUCTION	OPERATION
COUNTY	• Employment demand • Transportation	• County revenues (all counties) • Infrastructure and service costs (Rio Blanco)
COMMUNITY	• Population effects, 1984 • Temporary worker housing and services (Parachute, Rifle, Meeker, Craig, Rangely, Maybell, Baggs, Rawlins, Casper) • Change in business receipts • Nuisance factors (Maybell, Rangely, Baggs, Casper)	• Population effects 1985 or 1986 (Meeker only) • Housing and other services (Meeker only)

- increase in traffic that would have regional intercity roads operating beyond design capacities for Service Level C, or that would result in a measurable increase in accident rate per million vehicle miles travelled (i.e., ≥ 1).

- nuisance factors that would result in uncompensated loss of livelihood, or damage to human health

Operation

- permanent population change in Meeker greater than 10 percent

- demand for permanent housing and for community services and facilities in excess of availability

- change in county revenues greater than 10 percent

- inability of Rio Blanco County and the town of Meeker to meet the costs of providing necessary facilities and services to new residents prior to receipt of project revenues

Unfortunately, there is no collection of empirical evidence in the social sciences to support and justify the universal use of particular threshold figures as failsafe. Attempts to quantify qualitative social change are admittedly inexact and value-laden. It is felt that a population growth rate threshold of 10 percent for definition of significance in the La Sal EIS is reasonably conservative, given the range of figures currently in use by other analysts.

In this report, unless stated otherwise, "northwestern Colorado" refers to Garfield, Rio Blanco, and Moffat counties. "Southcentral Wyoming" refers to Carbon, Sweetwater, and Natrona counties. "Study region" refers to the six-county area.

AFFECTED ENVIRONMENT

Population

Predicting population changes for the six counties affected by the proposed action is problematic. All six counties will be affected by major resource developments, but the degree of change is dependent on a variety of factors. Future levels of oil shale production in northwestern Colorado, for example, will be determined by such factors as national energy supply and demand patterns, government incentives, and technological progress. Because projections of oil shale production vary so much, figures for anticipated population growth also vary. This is illustrated by recent projections of population for Garfield County, Colorado, which range from 36,100 to 113,910 for the year 1990 (CDLA, 1979; CDNR 1980).

Predicting the allocation of anticipated population among counties and communities is also problematic. Recent experience in Colorado indicates that workers do not necessarily choose to live in the same county in which they work (Willard, 1981). While most current oil shale projects are located in Rio Blanco County the majority of oil shale workers commute from Garfield County. For example, most C-b Tract workers now commute from Rifle (Weiner, 1981). Where people locate is influenced by personal preferences, social network, financial incentives, living conditions, proximity to work place, and availability of essential services.

There are many public and private agencies now generating population projections for the study region, particularly for northwestern Colorado. Each agency makes its own assumptions about the factors affecting resource development and population allocation, resulting in quite a wide range of figures.

For the purposes of this impact assessment, the U.S. Department of Commerce, Bureau of the Census, is used as the official source of population figures for 1960 through 1980. Population projections for Wyoming counties were obtained from the Wyoming Department of Administration and Fiscal Control, Division of Research and Statistics. Population projections for northwestern Colorado were obtained from the Colorado West Area Council of Governments (CWACOG).* Generally speaking, these projections are current, consistent for all counties potentially affected by the proposed action, and reflect a "worst case" scenario based on all announced proposed developments within the study region.

Population in the study region has been relatively sparse in recent decades (see Tables 2 and 3). While densities in all affected counties have increased substantially in the past decade, they are still far below the national average. Between 1960 and 1970, half of the counties experienced a net out-migration, and the other half experienced only slight increases in population. Around 1974, a steep growth trend began as a result of energy development projects (BLM, 1980a). Between 1970 and 1980, all six counties grew, with growth rates ranging from 30 percent in Rio Blanco County to 123 percent in Sweetwater County, compared to 30 percent for Colorado, 42 percent for Wyoming, and 11 percent for the United States. This relatively rapid growth is expected to continue accelerating over the next decade. The study region population is expected to increase by an additional 77,000 people, or approximately 43 percent , by 1985, mainly as a result of further coal, uranium, petroleum, and oil shale developments.

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*Both the Department of Local Affairs and the Department of Natural Resources have recommended use of CWACOG's population projections for the purposes of this impact assessment (Hecox, Reynolds, 1981).

Table 2. SUMMARY OF POPULATION TRENDS AND PROJECTIONS BY COUNTY FOR STUDY REGION

	County	1960[a]	1970[a]	1975[b,c]	1980[b,c]	1985[b,c]	1990[b,c]
COLORADO	Garfield	12,017	14,821	17,906	23,013	55,694	64,379
	Rio Blanco	5,150	4,842	5,349	6,294	18,711	24,696
	Moffat	7,061	6,525	8,336	13,129	19,392	25,703
WYOMING	Carbon	14,937	13,354	16,795	23,554	32,141	39,297
	Sweetwater	17,920	18,392	35,782	41,102	46,730	54,632
	Natrona	49,623	51,264	62,535	73,687	85,178	100,431
	TOTAL	106,708	109,198	146,703	180,779	257,846	309,138

Sources:

[a]U.S. Department of Commerce, Bureau of the Census, 1975.
[b]Wyoming Department of Administration and Fiscal Control, Division of Research and Statistics, 1980.
[c]Colorado West Area Council of Governments, 1980a.

Table 3. POPULATION DENSITIES (persons per square mile)

County	1960	1970	1980
Garfield County	4.01	4.95	7.50
Rio Blanco County	1.58	1.48	1.93
Moffat County	1.49	1.33	2.77
Carbon County	1.89	1.69	2.98
Sweetwater County	1.72	1.76	3.94
Natrona County	9.29	9.60	13.79
6-County Average	3.48	3.55	5.88
Colorado	16.90	21.27	27.73
Wyoming	3.40	3.42	4.84
United States	50.71	57.46	64.04

All affected communities are also expected to grow between now and 1984, the proposed year of construction (see Table 4). Several communities are predicted to double or triple in size. This is likely to strain community infrastructure and services.

> Impacts of oil shale development activity which occur away from the actual development sites are at least as important as the on-site development impacts. In fact, off-site community impacts resulting from an increase in population associated with development of energy activities may become the most significant constraint to energy development in Northwest Colorado...Because of the sparse population and lack of communities with significantly developed facilities at the present time, the work force associated with oil shale and other energy and major development activity in Northwest Colorado will be forced to commute to those population centers which can and will expand to accommodate their numbers.
>
> (CDLA, 1979).

Social Setting

Both Wyoming and Colorado are rich in energy resources, but until recently it was not economically feasible to develop these resources on a large scale. Sudden shifts in world energy supply/demand balances and pricing policies in the mid-70's, however, stimulated a sharp increase in demand for domestic energy production. Construction and operation of major resource development projects in the study region has resulted in rapid population growth. This is a dramatic change from the previous few decades, when the study region consistently experienced a small net out-migration annually.

Community infrastructures, built to accommodate the needs of small, isolated, stable populations in the past are now straining to accommodate the sudden influx of new residents. In situations of sudden rapid growth, the expansion of community facilities and services often lags behind population growth and need, because of capitilization problems, and because of the traditional planning attitude that

Table 4. COMMUNITY POPULATION CHANGE, 1980-1984

Community	1980	1984	% Change
Parachute[a]	448	1,865	316%
Rifle[a]	3,933	18.113	361%
Rangely[a]	2,026	5,919	192%
Meeker[a]	2,615	9,077	247%
Craig[a]	9,735	11,298	16%
Maybell[e]	466	NA	NA
Baggs	430[b]	964[c]	124%
Rawlins	11,485[b]	17,312[c]	51%
Casper	50,704[b]	60,394[d]	19%

NA = Not available.

Sources:

[a]CWACOG, 1980a.
[b]U.S. Department of Commerce, Bureau of the Census, 1981.
[c]Wyoming DEPAD, 1979.
[d]Natrona County, 1979.
[e]Moffat County Planner, March 1981.

provision of new facilities and services should be based on demonstrated need, rather than anticipated need. The result of this lag is temporary discomfort and inconvenience to community residents that can last several months or years. Classrooms may be overcrowded until new school facilities are built. Families may be forced to live in recreational vehicles until suitable housing is available. Restaurants and recreational facilities may be overcrowded.

The measurable, physical changes resulting from rapid growth in a community are probably not as important as the more subtle, sometimes intangible changes that take place in social structure and community residents' sense of well-being. Cortese and Jones (1979) have attempted to identify some of the changes in social, economic, and cultural systems that accompany "the boomtown phenomenon," which they define as a 15 percent annual population growth rate. They describe boomtowns as having increased cultural diversity, increased professionalism, and increased specialization and bureaucratization.

As communities grow, political structures, social control mechanisms, and community institutions tend to become more formalized. The small town "where everyone knew everyone" is transformed into a community with a majority of new residents and greater diversity in value orientations and lifestyles. Informal social networks give way to the formation of voluntary organizations and special interest groups. Informal leaders are replaced by elected officials, and there is a greater reliance on formal or legal processes.

The way people adapt to these physical and non-physical changes varies from community to community, and from individual to individual. For some business people, youths, and new residents the rapid growth spurred by energy development can mean an increase in income and opportunities. For others, e.g., persons on fixed incomes, unemployed

spouses, long-term ranchers and livestock operators, the rapid growth may cause financial hardship, psychological stress, and a general perceived decline in the quality of life. Elderly long-term residents on fixed incomes can be affected adversely by local demand-pull inflation. Rapid changes in the social system can cause long-term residents to become alienated as they lose their "sense of community." Resentment toward the new residents can build and add a psychological burden to the physical problems all community residents must confront. The results can include loss of worker productivity and increase in social and family problems (Rocky Mountain News, January 31, 1981; Freudenberg, 1980).

In both Colorado and Wyoming there are current examples of negative boomtown effects in communities where planning has not kept pace with the demands of rapid growth. It is understandable that residents of the study region do not want to duplicate these cases. Energy developments and their social and economic impacts are controversial issues which receive a great deal of attention and interest in this region. Already a variety of government assistance programs have been developed to help communities prepare for anticipated rapid growth.

<u>Employment and Income</u>

Table 5 summarizes trends in labor force, employment, and unemployment rates over the past decade in the study region. In all counties, total labor force and employment increased between 1975 and 1979. The regional labor force grew from 63,661 to 89,856; an increase of 41 percent. The most rapid growth took place in Moffat County, which experienced an 80 percent increase in labor force over the four year period.

Table 5. LABOR FORCE, EMPLOYMENT, AND UNEMPLOYMENT RATES

	Total Labor Force			Total Employed			Unemployment Rate - %		
	1970	1975	1979	1970	1975	1979	1970	1975	1979
Garfield County[a]	6,812	9,765	11,672	6,520	9,268	11,163	4.3	5.1	4.4
Rio Blanco County[a]	2,237	2,039	3,146	2,143	1,973	3,098	4.2	3.2	1.5
Moffat County[a]	2,921	4,247	7,639	2,820	3,977	7,289	3.5	6.4	4.6
Carbon County[b]	5,750	6,913	10,106	5,500	6,647	9,924	4.3	3.8	1.8
Sweetwater County[b]	7,130	14,497	19,132	6,770	13,920	18,653	5.0	3.8	2.5
Natrona County[b]	21,920	26,200	38,161	21,040	25,264	37,329	4.0	3.6	2.2
Study Region Total	46,770	63,661	89,856	44,793	61,049	87,456	4.2	4.1	2.7
Colorado[a]	900,642	1,162,083	1,410,681	869,534	1,101,096	1,365,301	3.5	5.2	3.2
Wyoming[b]	137,950	165,869	223,000	131,810	158,888	217,000	4.5	4.2	2.7

Sources:
[a] Colorado Division of Employment and Training, Labor Market Information Branch, 1980.
[b] Wyoming Employment and Security Commission, Research and Analysis Section, 1981.

Between 1975 and 1979, the unemployment rate decreased in all counties. The average 1979 unemployment rate for the study region was 2.7 percent, well below the national average of 5.8 percent, but equal to Wyoming's average, and only 0.5 percent lower than Colorado's average unemployment rate for 1979. Labor markets in this area are expected to remain tight for the foreseeable future (BLM, 1980a).

The rapid increase in employment since 1975 has been caused primarily by natural resource developments in the study region. This has resulted in significant sectoral shifts in employment. Agriculture, the traditional economic backbone of the region, has continually declined in importance; mining, construction, trade, and services have increased in importance, particularly over the past decade. These trends will continue as new mines and energy facilities are constructed and operated throughout the 1980's.

Table 6 shows average per capita personal incomes for study region counties. Over this period, per capita incomes have risen substantially, but they are still below state averages. Because of the numerous major resource development projects proposed for the study region over the next decade, and the competitive local labor market, average income should continue to increase rapidly, to equal or surpass the state averages.

Revenues

Total county revenues for 1980 are shown in Table 7. Property taxes are the main source of county revenues, but in the future, revenues from utilities will become more significant. In Colorado, counties affected by rapid resource development also depend on grants from the Oil Shale Trust fund to help meet capital cost requirements in advance of development and to mitigate social and economic impacts.

Table 6. PER CAPITA PERSONAL INCOME

	1973 (in dollars)	1978 (in dollars)
Garfield County[a]	4,633	7,574
Rio Blanco County[a]	4,643	8,940
Moffat County[a]	4,892	9,166
Colorado[a]	5,021	8,116
Carbon County[b]	5,014	8,915
Sweetwater County[b]	6,005	9,197
Natrona County[b]	5,808	11,450
Wyoming[b]: SMSA counties*	5,461	8,817
Non-SMSA counties	4,875	8,663

*SMSA counties have population greater than 50,000.

Sources:

[a]Colorado Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, 1980.

[b]Wyoming Employment and Security Commission, Research and Analysis Section, 1981.

Table 7. TOTAL COUNTY REVENUES, 1980

Garfield[a]	$24,456,447.88
Rio Blanco[b]	$ 5,212,031.00
Moffat[c]	$ 6,424,374.00
Carbon[d]	$27,760,825.87
Sweetwater[e]	$ 6,274,097.43
Natrona[f]	$43,249,668.28

Sources:

[a]Garfield County Treasurer's Office, March 1981.
[b]Rio Blanco County, Consolidated Budget Summary, 1980.
[c]Moffat County Clerk's Office, March 1981.
[d]Office of the Carbon County Treasurer, January 1981.
[e]Sweetwater County Clerk's Office, January 1981.
[f]Office of the Natrona County Treasurer, March 1981.

Table 8 shows 1979 total retail sales for the counties and communities potentially affected. Population of these areas has been increasing relatively rapidly. Business receipts have also increased, although not in direct proportion to the rate of population growth. In the community of Meeker, for example, local businesses are reported not to be benefitting significantly from recent rapid growth. This is because Meeker residents tend to make monthly shopping trips to the larger population centers of Craig or Rifle, where the range of goods available is greater and prices are often lower (Payne, 1981).

Transportation

The purpose of this section is to present the current and projected use of regional roads, and comment on how this relates to effects on the human environment in the study region. Road segments potentially affected by the proposed action are identified on Figure 1. Recent resource developments in the study region have resulted in increased traffic on all road segments, and particularly on segments B_1 and B_2. Traffic throughout the region is expected to continue increasing over the next decade.

Road traffic is expected to increase most substantially in northwestern Colorado, as a result of the numerous planned shale oil developments. The Colorado West Transportation Plan states that:

> The impacts of energy development on the regional roadway system will be significant. In particular, the potential for a high number of heavily loaded energy trucks to deteriorate pavement structure, increase congestion and impact existing communities will arrive concurrent with energy development. The need to transport employees from their homes in existing settlements to remote energy development sites will place increasing volume demand on the capacity of the existing roadways.
>
> (TDA, 1980).

Using CWACOG's population projections and energy development scenarios, the planners concluded that most of the substantial

Table 8. TOTAL RETAIL SALES, FISCAL 1979

Parachute[a]	$ 1.3 million
Rifle[a]	$ 33.5 million
Rangely[a]	$ 26.5 million
Meeker[a]	$ 14.9 million
Craig[a]	$ 96.1 million
Maybell	NA
Carbon County[b]	$121.7 million
Natrona County[c]	$455.5 million

Note: Wyoming retail sales figures are not available disaggregated to the community level. Sweetwater County is not included since construction workers would not be located in any Sweetwater County communities.

NA = Not available.

Sources:

[a]Piatt, 1981.
[b]Wells, 1981.
[c]Moore, 1981.

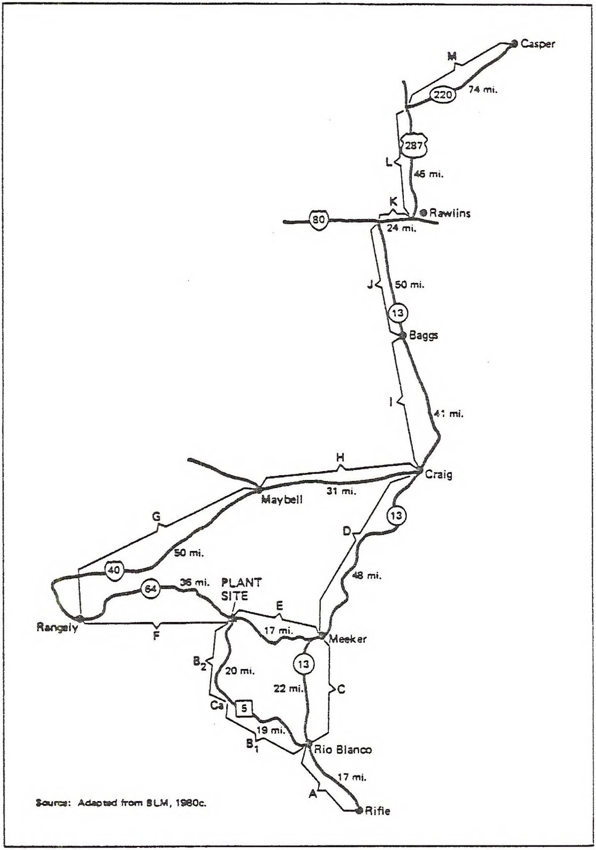

Figure 1. ROAD SEGMENTS POTENTIALLY AFFECTED BY THE PROPOSED ACTION

increase in regional intercity traffic volume would occur by 1985 (TDA, 1980).

Table 9 displays the capacity ratings, expressed in vehicles per hour at Service Level C, for road segments potentially affected by the proposed action and alternatives. Table 10 shows current average daily traffic volumes, and projections of estimated daily traffic for 1985. Table 11 indicates current accident rates on potentially affected road segments, expressed as the average number of traffic accidents per million vehicle miles travelled.

The recent Rio Blanco County-wide Capital Improvements Program (September 1980) addresses regional transportation problems:

> The transportation issues facing Rio Blanco County will be of serious concern in the next five years. Increasing volumes and loads will create conflicts and problems on the state highways and with the Piceance Creek Road. Inadequacies in the road network will become more evident as accidents and road damage occur. Company employee busing will help alleviate some of the problems. However, planning and adequate funding for transportation needs by both the private companies and public sector must continue in order to ensure an effectively functioning system.
>
> Adequate thought and advanced preparation must be given to worker, material, and product movement. Permits and new developments must be carefully scrutinized in terms of potential transportation conflicts.
>
> (CWACOG, 1980b).

Accident rates are estimated to be in the range of 0-4 accidents per million vehicle miles (APM) for most of these segments, with a few exceptions. Accident rates are in the 4-7 APM range on road segment E and on parts of segments A, D, and I. The highest accident rate in the region, in the 7-10 APM range, is found on a 10-15 mile stretch north of Meeker, on segment D.

Table 9. CAPACITY RATINGS OF POTENTIALLY AFFECTED ROAD SEGMENTS

	Road Segment	Capacity Rating in Vehicles/Hour (Service Level C)
Colorado[a]	A	922
	B_1	500[c]
	B_2	500[c]
	C	905
	D	912
	E	570
	F	749
	G	692
	H	692
	I	912
Wyoming[b]	J	729
	K	4980
	L	784
	M	784

Sources:

[a]Colorado State Highway Department, 1981.
[b]Wyoming State Highway Department, 1981.
[c]BLM, 1980c.

Table 10. REGIONAL ROADWAY TRAFFIC VOLUMES, 1980 and 1985

State	Road Segment	1980 ADT	1985 ADT
Colorado[a,b]	A	1300	1500
	B_1	300	350
	B_2	350	400
	C	1350	1500
	D	900	950
	E	600	630
	F	870	910
	G	800	1100
	H	1150	1750
	I	1800	2500
Wyoming[c]	J	800	1032
	K	6070	7527
	L	2040	2489
	M	1360	1659

ADT = Average daily traffic.

Sources:

[a]BLM, 1980c.
[b]TDA, 1980.
[c]Wyoming State Highway Department, 1981.

Table 11. CURRENT ACCIDENT RATES OF POTENTIALLY AFFECTED ROAD SEGMENTS

State	Road Segment	Accident Rate PMM
Colorado	A	4.04[a]
	B_1	<4[c]
	B_2	<4[c]
	C	2.88[a]
	D	4.26[a]
	E	4.56[a]
	F	3.00[a]
	G	1.70[a]
	H	1.54[a]
	I	4.22[a]
Wyoming	J	1.58[b]
	K	1.65[b]
	L	1.97[b]
	M	1.86[b]

PMM = Per million vehicle miles.

Sources:

[a] Colorado State Highway Department, 1981.
[b] Wyoming State Highway Department, 1981.
[c] TDA, 1980.

Housing

In small communities and rural areas, there is less speculative housing construction than in larger urban centers. Housing tends to be built only as need is demonstrated. When the population of small communities increases substantially and suddenly, as is happening in many communities throughout the study region, any available surplus capacity is utilized quickly. The price of housing can escalate, and in times of high mortgage interest rates, supply is slow to respond to demand in the absence of special programs to alleviate the housing "crunch."

Parachute. The community of Parachute is expected to increase its population from 448 in 1980 to 1,865 by 1984 (CWACOG, 1980a). The community's water and sewer systems will be expanded to accommodate up to 3,000 people in future.

At present there are no motels, hotels, vacant trailer court spaces, or rental units of any kind available in the community (Cutter, 1981). Anticipated developments in Parachute's temporary housing market include the following:

- Exxon is constructing a trailer court outside city limits that will contain 500-550 units. It is scheduled to open in May, 1981, and will be available to the public.

- Union Oil has been asked by the county to provide worker housing. The company will open a 40-unit trailer court this year, but it is not expected to be open to the public. Union Oil has also purchased the only existing trailer court in Parachute. This 27-unit trailer court will be closed to the public as of April 30, 1981. Union will also build a

total of 20 apartment buildings, each with 24 units, for their workers.

- Private firms plan to build a total of 80-90 townhouses and condominiums in Parachute. Date of availability is unknown.

- A private firm plans to build 20 single-family units in Parachute. Date of availability is not known.

- Parachute is investigating land annexation and land acquisition for hotel/motel construction.

(Cutter, 1980).

Parachute's housing shortage should be helped considerably by the construction of the new town of Battlement Mesa a few miles away. Over the next 10 to 15 years, more than 7,000 housing units will be built, mainly to accommodate Colony employees. By 1985, Battlement Mesa, Inc., expects to construct 2,500 apartments, 1,700 single family homes, 700-800 town houses, and 1,000 mobile homes. By the end of 1985, the mobile homes will be phased out and replaced by an additional 300 single family units (Kane, 1981).

Parachute will share some services and facilities with the new town, including sewer and water, fire protection, and some schools and recreation facilities (Glenwood Post, January 9, 1981). It is likely that hotels/motels and other forms of temporary housing will be built to serve the needs of the Battlement Mesa population, and that Parachute will be able to take advantage of some of these facilities as well.

Rifle. Rifle's population is expected to increase from 3,933 in 1980 to 18,113 in 1984 (CWACOG, 1980a). This makes it probably the

fastest growing community in Colorado's oil shale country. The community's sewer system is now being upgraded to accommodate up to 12,000 people.

Rifle currently has a total of 136 units in 4 hotel/motels, all of which are fully occupied. A high proportion of the occupants are energy workers. Rifle's four mobile home parks, with a total of 414 spaces, are also filled to capacity (BLM, 1980a).

Some 3,000 housing units are currently in progress or recently approved. These are virtually all permanent in nature, and include single family, multi-family, and condominium units. A trailer park which will contain approximately 160 lots has been approved, and two additional motels have been unofficially proposed (Spillman, Bean, 1981).

Rangely. Rangely's population is expected to expand from 2,026 in 1980 to 5,919 in 1984 (CWACOG, 1980a). A study recently completed by Community Services Collaborative of Boulder, Colorado, estimates that Rangely will be short 700 rental units and 1,100 single family units within 5 years (Rangely Times, Jaunary 22, 1981). At present, four housing subdivisions, with a total of 188 single family and 168 multi-family units, are approved or under construction. A 40-unit apartment complex, which would be Rangely's largest, is planned for construction in 1981.

Rangely currently has 4 hotel/motels with a total of 88 units. These are reported to be full from spring through December, and almost full from December through spring. Approximately 95 percent of the units are occupied by energy workers (BLM, 1980b). In 1980, 46 motel units were constructed, but no more units have been officially proposed for 1981 (Beard, 1981). Rangely also has five mobile home parks

with a total of 190 spaces, and a 28-space camper park. Two facilities, which will accommodate a total of 341 recreational vehicles, will be built in the near future (BLM, 1980b).

Meeker. Preliminary 1980 census figures indicate that while Meeker's population increased by 251 between 1970 and 1980, housing units in the town increased by 320 during the same period (Meeker Herald, December 4, 1980). Meeker's planners feel that recent growth has been accommodated well, and that the town is reasonably "caught up" now in terms of immediate need for basic municipal services and permanent housing lots. Grants from the Oil Shale Trust Fund have been used to expand local schools and sewer treatment facilities. The town's sewer system capacity is now being doubled, and will soon be capable of serving a population of 8,000. Housing supply is still tight, however. This is due partly to high interest rates, rather than a shortage of serviced land. There are lots available for construction in Meeker now, and several new subdivisions are planned, including a 1400-acre Planned Unit Development (PUD) which is being considered to meet Meeker's future housing needs. The community is working to annex the land needed for this PUD, and funds are being sought under the Department of Housing and Urban Development's 1980 New Community Act. The proposed development, called "Meeker Terrace" would be phased, and could accommodate an eventual population of 16,000 (Rehburg, 1981).

The temporary housing market in Meeker is very tight now. Meeker currently has six hotels and motels, with a total of 95 rooms. These facilities are almost always filled to capacity. It is estimated that approximately two-thirds of the occupants are energy workers (BLM, 1980b). There are five mobile home parks in Meeker, with a total of 80 spaces. These are currently full, and are reported to have a 6-8 month waiting list (Smith, 1981). The community accommodates up to 20

recreational vehicles. There are also about a dozen tourist resorts within 30 miles of Meeker. These provide temporary accommodation mainly to hunters. One of Meeker's hotels is presently planning an expansion, and a new 48-room Best Western hotel is in early planning stages (BLM, 1980b). A 400-space mobile home park has been approved to house workers from Rio Blanco Oil Shale Company's planned expansion at Tract C-a.

Meeker officials are not seeking community growth as actively as other communities, such as Rangely, are. In fact, concern has been expressed about maintaining quality temporary housing facilities in and near the town when the needs of energy development projects place a strain on local facilities. Meeker's population is forecast to increase 247 percent by 1984 (see Table 4).

According to Department of Natural Resources estimates, the following percentages of workforces associated with major announced oil shale developments would settle in Meeker.

Project	Percent Workforce to Live in Meeker
Superior	35%
Tract C-a	20%
Tract C-b	20%
Equity	20%
(Exxon) Carter Oil	20%
Tract C-c	30%
Tract C-d	30%
Multi Mineral	30%

(CDNR, 1980).

These workers and their families would need an estimated 2,240 additional housing units in Meeker in the next 5 years alone.

The Rio Blanco County-wide Capital Improvement Program addressed the issue of housing shortages resulting from energy developments, and suggested that companies will have to participate in finding solutions to the problem.

> Regardless of the efforts made, housing is apt to continue to be a significant problem area. It should be noted, however, that local government does not believe that serious housing problems are necessarily inevitable, and that much can be done to mitigate housing problems. The issue may boil down to, depending upon what is done or not done in the area of housing, how receptive the County will continue to be with regard to new energy development(s) should housing problems get out of hand. The County has in the past had an open, accommodating posture towards energy development, but not at any cost.
>
> If private industry and the federal government desire continued and expanded development of energy resources in Rio Blanco County, then each should recognize its responsibility to be actively involved in housing efforts in order to properly and effectively accommodate growth. It is the County's assumption that increased (cost effective) domestic energy production is in the national interest and it is a corollary policy that the cost of the energy development must be equitably borne by all, particularly the initiators and generators of impacting energy development.
>
> (CWACOG, 1980b).

The main problem faced by rapidly-developing communities like Meeker is the lag time between construction of new water and sewer systems, as well as the provision of other necessary facilities and services, and the recovery of costs through tax revenues. Fortunately, state and federal governments have been responsive to the special planning needs of communities affected by energy developments. The Oil Shale Trust Fund, for example, is providing grants to communities in northwestern Colorado to help them prepare for population growth. The Energy Impact Assistance Fund, administered by the Department of Local Affairs, also enables affected communities to initiate preventive programs, to supplement the more traditional responsive approach

to planning community services. It is impossible to predict the exact type and extent of "boomtown" effects Meeker will be experiencing in the mid-80's. The local level of awareness and preparedness, plus the availability of a variety of assistance programs, will put the community in a much better position to cope with rapid change than many boomtowns that are caught unaware.

Craig. Craig's population is expected to grow from 9,735 in 1980 to 11,298 in 1984 (CWACOG, 1980a). This is a significantly slower rate of growth than the community experienced over the past 5 years, when major resource developments nearby caused the population to "boom." Concern was expressed over the very high proportion of mobile homes in Craig's total housing stock. In 1978, 38 percent of Craig's housing was mobile homes. This was almost twice the percentage found in Rawlins (20 percent), and much higher than the 7 percent found in Meeker (BLM, 1980a). This high figure concerned planners and social workers because of the often assumed association of negative boomtown effects with the formation of mobile home "ghettoes."

Craig's hotels and motels may not be quite as crowded as they were at the height of the town's recent boom period, but occupancy rates are still very high. During hunting season, during the summer fair and horse races, and when construction crews are located in town, the hotels are filled to capacity. Currently, Craig has approximately 447 motel/hotel rooms. An additional 230 rooms will be built in the near future, including 175 rooms in the new Holiday Inn now under construction. There are approximately 75 temporary trailer hook-up facilities in the community. The availability of temporary housing in 1984 is difficult to predict, particularly because of the erratic patterns of use by energy workers who live in Craig on a part time or temporary basis (Morelle, 1981).

Maybell. The community of Maybell has only one motel, with a total of ten units. The motel closes for the winter, but accommodates tourists, energy workers, and hunters through summer and fall. There is a park in the community where camping is permitted in summer, and where a limited number of electrical hook-ups are available (Steele, 1981).

Currently there is a moratorium on construction in Maybell, because of the insufficient local water supply and sewage treatment facilities. Steps are being taken to alleviate this situation and lift the moratorium as soon as possible (Sorenson, 1981).

Maybell is a very small unincorporated community that is not likely to expand significantly by 1984. It is doubtful that more extensive temporary housing facilities would be available in the forseeable future.

Baggs. Population in Baggs is projected to more than double, from a current level of 430 to 964, by 1984 (CWACOG, 1980a). The community recently improved its water system to accommodate up to 1,500 people.

Permanent housing stock in Baggs consists of 52 single-family units, 8 multifamily units, ad 72 trailers or mobile homes. There are 3 or 4 motels with approximately 50 units in total. There is strong demand for more housing in Baggs, including rental units. Proposed new housing developments in Baggs will include more than 125 units, including space for at least 39 mobile homes (Hunt, Buchanan, 1981). Using an estimated household size of 2.75 persons, the planned developments would still fall short of 1984 needs by approximately 70 units.

Rawlins. The local housing market was very tight in Rawlins late in 1980, when the supply of temporary housing was a particular problem.

A 1980 survey conducted by city staff disclosed that 181 motel units were being used as permanent quarters. Mobile homes and campers were found scattered outside city limits, because properly serviced spaces are not available within the city (BRW/Noblitt, 1980).

Over the past few months, however, housing availability in Rawlins has improved dramatically. The overall vacancy rate has risen from 0 percent to approximately 2-3 percent (Young 1981). Due to the closing of one gold mine, a decline in oil exploration, and new housing construction, Rawlins could now accommodate a construction workforce of 132 relatively easily, either in trailer spaces or motel rooms (Young 1981).

Rawlins has 24 hotels and motels with a total of 1,029 units, as well as 33 mobile home parks, with approximately 500 spaces. Two new hotel proposals are being reviewed by the Rawlins City Planning Department. With large-scale coal developments expected to begin construction in the Rawlins area beginning in 1983-84, it is difficult to predict the availability of temporary accommodation at that time. With advance planning, however, the applicant should be able to reserve adequate temporary accommodation for construction workers in Rawlins.

<u>Casper</u>. A recent housing supply and demand study for the Casper area concluded that by 1984 there would be a net shortage of single-family housing in Casper, but that there would be a net excess of rental homes and mobile homes (Mobius and Stuart/Nichols, 1980). Tables indicating the projected supply and costs of rental housing in Casper, 1981 to 1984, are included in Appendix B.

The city has 38 hotels and motels, with a total of 2,013 units. Several campgrounds are located in or near the city. Most have

hook-ups and a variety of user services. Camping in Natrona County parks, including Pathfinder, Alcova, and the mountain parks, is limited to 14 days (Casper Area Chamber of Commerce, undated).

Urban Recreation

Many of the long-term residents of the study region are oriented toward outdoor recreation. For some, the opportunity for hunting and fishing was what attracted them to settle there in the first place. The recent influx of new residents from other parts of the country is not only increasing overall recreation demand, it is also resulting in greater emphasis on the need for indoor recreational facilities. As communities in the study region experience the demands and stresses associated with rapid growth, urban recreational facilities can provide an important outlet for frustrations, thereby protecting community mental health.

Community facilities in the study region are used not only by permanent residents, but also by construction workers located in or near the communities temporarily. Table 12 shows some of the key entertainment and recreation facilities that are likely to be of interest to construction workers temporarily housed in the affected communities. Many of the communities listed now have active Recreation Committees and/or Recreation Planners who are conducting surveys to identify and prioritize urban recreation needs, including demands likely to be made by new construction and operation workforces in the area.

Table 12. URBAN ENTERTAINMENT AND RECREATIONAL FACILITIES

Community	Bars	Restaurants Serving Alcohol	Restaurants	Movie Theatres (Including Drive-ins)	Public Swimming Pools	Tennis Court Facilities	Golf Courses	Bowling Alleys
Parachute[1]	2	0	1	0	0	0	0	0
Rifle[1]	2	3[aa]	6	1	1	1	1	0
Rangely[2]	1	3	3	1	1	2[a]	1	1[b]
Meeker[2]	1	4	4	0	0[c]	1	1	1
Craig[3]	3	11	11	2	3[d]	3	1	1
Maybell[4]	0	0	1	0	0	0	0	0
Baggs[5]	2	1	2	0	0	0	0	0
Rawlins[6]	11	9	12	2	2	6	1	1
Casper[7]	45[e]	30[e]	57[e]	6	7	6	3	4

[aa] Two more under construction: estimated opening = 1981.
[a] One at community college: part-time public access.
[b] At community college: part-time public access.
[c] One more under construction: estimated opening = 1981-82.
[d] One more under construction: estimated opening = 1981.
[e] Approximate count.

Sources:

[1] Erickson, 1981.
[2] Vongurad, 1981.
[3] Robinson, 1981.
[4] Steele, 1981; Robinson, 1981.
[5] Chastek, 1981.
[6] Wells, 1981.
[7] Zielke, 1981.

ENVIRONMENTAL CONSEQUENCES

Construction

The potentially adverse social and economic impacts identified for the proposed action would be negligible under ordinary circumstances, but become significant in the context of the very rapid growth and development expected to occur in the study region over the next five years. The cumulative effects of simultaneous major resource development projects will aggravate current shortages of local labor and community accommodation, so that the applicant would have difficulty finding temporary lodging for workers in many of the communities along the proposed route.

Population Effects. The proposed action would be built in four spreads. Information about workforce size and the location of spreads is summarized in Table 13. In addition to pipeline construction workers, there would be a workforce of 60-65 constructing each pump station. No more than 40-45 of the pump station workers would be on site at any one time. Initially only one pump station will be built, at the Colony facility near Parachute. It is estimated that construction phase workers would be approximately 55 percent skilled and 45 percent unskilled.

Construction phase impacts would differ depending on whether the workforce were hired locally or brought in from outside the study region. For this analysis it is assumed that construction workers would be nonlocal, since it is unlikely that the number of skilled workers needed for pipeline construction would be available in the study region in 1984. It is also assumed that, because of the relatively short duration of construction, workers would not bring dependents with them into the study region. Any population impacts associated with construction of the proposed action would be short-term.

Table 13. CONSTRUCTION SPREAD LOCATION, TIMING, & WORKFORCE

Spread	Length	Location	Construction Time[a]	Workforce[b]
#1	71 mi.	Parachute Pump Station to Maybell	4 mos.	100
#2	35 or 41 mi.	Piceance Creek to Rangely	2.5 mos.	100
#3	139 mi.	Maybell to Ferris	3 mos.	132
#4	69 mi.	Ferris to Casper	3 mos.	132

[a]Construction time assumes six 10-hour days per week.
[b]Workforce figure for each spread includes six La Sal Pipe Line Co. inspectors.

Source: La Sal Pipe Line Co., 1981.

Employment. The criterion for definition of significance for construction phase employment impact is employment demand on the local workforce greater than 15 percent. Workforce estimates were not made for affected counties in 1984. It is expected, however, that the 1984 workforce in all affected counties will be larger than the current workforce. The employment demand of the largest anticipated construction crew (132 workers) would not exceed 4.2 percent of the smallest current county labor force- that in Rio Blanco, with a 1979 labor force of 3,146. The total number of construction workers involved in all four spreads plus the pump station would be approximately 530, or less than 0.6 percent of the total study region labor force, which was 89,856 in 1979 (see Table 5).

Business Receipts. The criterion for definition of significance is a temporary change in local business receipts greater than 15 percent. Because of the relatively small size of construction crews, and their short anticipated length of stay in any one community, their presence would not increase local business receipts by 15 percent or more. Construction worker spending in the study region would, however, have a beneficial effect on local and regional economies.

Housing and Community Services. The criterion for definition of significance is demand for temporary housing and other community services that exceeds surplus capacities. The Housing Section describes availability of temporary accomodation in each community in the study region. Current surplus capacity of temporary housing in seven of the nine communities assessed is extremely small. The exceptions are Rawlins and Casper, which have a good supply and wide variety of temporary housing options. The shortage of temporary accommodation in Parachute, Rifle, Rangely, Meeker, Craig, Maybell, and Baggs is not expected to change by 1984. The total number of units may increase, but demand is also expected to increase as a result of simultaneous

major resource development projects. As a result, accomodating even the small pump station crew of 40-45 workers in those communities would be problematic.

It should be noted that while sufficient temporary accommodation probably would not be available in Parachute in 1984, the new town of Battlement Mesa will offer a wide range of housing types by that time. Temporary accommodation for construction workers could be available during the proposed construction period.

<u>Recreation</u>. Recreation facilities in each community are described in the Urban Recreation Section. The expansion of recreation and entertainment opportunities for energy workers is a controversial topic, particularly in some parts of northwestern Colorado. In some oil shale communities, for example, increases in social problems have been attributed to the shortage of recreation facilities for locally-based energy workers (Glenwood Post, January 9, 1981; Rifle Tribune, January 14, 1981). On the other hand, community residents can resent construction workers' use of local facilities. They feel they are subsidizing public facilities for use by non-residents. In the case of private facilities, local businesspeople often benefit from the patronage of construction workers, but community residents may be inconvenienced by overcrowding of limited facilities.

The impact of construction workers associated with La Sal's proposed action on urban recreation facilities would be minimal. Because of the speed of construction, workers would be in the vicinity of any particular community only a short period of time. Furthermore, crews would probably work six ten-hour days per week, so they would have little leisure time to spend in the communities.

<u>Transportation</u>. The regional road system would be affected by some increase in traffic as a result of the proposed action, for transportation of pipeline supplies and workforce, during the construction phase. Table 14 shows the anticipated volume of truck traffic carrying pipe to work sites. Estimated gross weight of the trucks is 80,000 lbs. loaded and 26,000 lbs. empty. For all segments, the truck movements would occur within a time frame of approximately two weeks.

Workforce transportation patterns are difficult to estimate, because these would depend upon workforce locations and mode of transport. In the worst case scenario, workers would not be bussed to the worksite. Instead they would commute to the worksite by private automobile, with an average of 1.5 persons per vehicle. Since the Wyoming construction spreads would employ 132 workers, this would mean an addition of 88 vehicles per working day (morning and evening) on any affected road segment. For Colorado work crews of 100 persons it would mean approximately 66 round trips per day.

Table 15 summarizes the total "worst case" temporary increase in daily truck and private vehicle traffic throughout the study region that could result from the proposed action. Increases in truck traffic would last only for a 2-3 week period on any one road segment. Commuter vehicle increases are shown for all road segments, since commuting routes are not known at this time. None of the temporary increases identified would have regional intercity roads operating beyond their capacity ratings for Service Level C, nor would they increase the accident rates on affected segments by a level of statistical significance.

Transportation of pipeline construction materials would result in some deterioration of road surfaces and subsequent increases in road

Table 14. TRUCKLOADS OF PIPE ON AFFECTED ROAD SEGMENTS FOR PROPOSED ACTION, 1984

Road Segment	Truckloads of Pipe
A	852
B_1	852
B_2	852
C	-
D	-
E	-
F	1,212
G	720
H	720
I	306
J	3,540
K	3,684
L	1,656
M	1,656

Source: La Sal Pipe Line Company estimates.

Table 15. MAXIMUM TEMPORARY INCREASE IN REGIONAL TRAFFIC CAUSED BY PROPOSED ACTION

Road Segment	ADT (1985)	Estimated Maximum Daily Traffic: Proposed Action		Total ADT Increase
		Worker's Vehicles	Pipe Trucks	
A	1,500	133	142	275
B_1	350	133	142	275
B_2	400	133	142	275
C	1,500	133	-	133
D	950	133	-	133
E	630	133	-	133
F	910	133	202	335
G	1,100	133	120	253
H	1,750	133	120	253
I	2,500	133	52	185
J	1,032	176	590	766
K	7,527	176	614	790
L	2,489	176	276	452
M	1,659	176	276	452

ADT = Average daily traffic.

maintenance costs. No weight-restricted bridges would be adversely affected.

Nuisance Factors. During pipeline construction there would be some unavoidable nuisance factors that would affect people living close to the pipeline route or project supply transportation routes. Ranchers might have their activities interrupted for a few weeks on the ROW to allow for trenching, laying pipe, and reclaiming land.

Rangely, Maybell, Baggs, and Casper are all located within 5 miles of the proposed action. Some of the residents of those communities might be temporarily inconvenienced by noise and dust from nearby construction. Duration of such nuisances would be short, probably less than one week in any location, and would not result in loss of livelihood or damage to human health. Residents along some road segments would experience temporary, short-lived increases in noise levels due to truck transport. None of these nuisance factors, however, would constitute a significant impact.

Operation

Population Effects. The operation phase would employ approximately 35 workers, 25 of whom would settle in Meeker. The remaining ten would live in other communities or rural areas along the proposed route, and would not have a significant effect on existing population.

Assuming an average family size of 2.55 (CWACOG, 1980a) and an employment multiplier of 1.6 (which is liberal considering the leakages that tend to occur in small communities like Meeker), it is possible to calculate the total population increment in Meeker resulting

from operation of the proposed action as follows: 25 x 1.6 x 2.55 = 102 persons. This would be an increment of only about 1 percent of Meeker's projected 1984 population, and therefore is not considered a significant impact in and of itself. It is important to point out, however, that Meeker will be growing at a very fast pace over the next decade, because of other developments planned for that area. The resultant cumulative impacts of simultaneous developments will be significant. Although the La Sal operation workforce is very small, it would contribute to the overall cumulative impacts of resource development projects in the Meeker area.

Housing and Other Services. The number of housing units that would be required to accommodate new residents who come to Meeker as a direct or indirect result of the proposed action is estimated at 40. This figure is obtained by multiplying the number of operations jobs (25) by the employment multiplier (1.6). This figure represents the "worst case", since it is probable that some of these jobs would be held by persons who already occupy homes in Meeker.

The current and projected availability of housing in Meeker is described in the Housing Section. The supply of single family and rental housing in Meeker is very tight now. If mortgage interest rates drop, this situation could improve in the short term. By 1985-86, however, demand for housing in Meeker is expected to be extremely high because of simultaneous energy resource developments in the area. Meeker's new PUD, if approved, could accommodate up to 16,000 people. This would take care of the town's anticipated housing needs. According to the Rio Blanco County planner, plans for the PUD are progressing. The water system has been planned, and it is expected that some mobile home lots will be prepared this year (Rehburg, 1981).

Expansion of community services such as water supply, medical care, and police/emergency protection is dependent upon demonstrated

demand (Payne, 1981). Provision of other types of services, such as restaurants, bars, theatres, stores, etc. depends upon private sector response to anticipated demand. In Meeker this type of response has been slow in recent years. Currently, many residents drive to Craig or Rifle for entertainment and purchases. This pattern is likely to continue, because Rifle and Craig will maintain larger populations in spite of Meeker's growth. Thus, those towns will probably continue to offer a better selection of goods and services, and possibly lower prices as well, due to larger volumes of sales.

It is estimated that approximately 25 of the new 102 Meeker residents would be school age children. While Meeker schools have some excess capacity at present, this will not be the case by 1985-86, when there will be high demands on educational facilities by incoming residents. Unless more school expansions are approved on the basis of anticipated demand there will be virtually no excess capacity in school facilities because of the cumulative effects of resource development projects (King, 1981).

The incremental population associated with the proposed action would be far below common standards for unit increases in other types of community services, such as health care facilities, police and fire vehicles and staff. Nonetheless, the situation for these services would be much the same as for education, i.e., even though the incremental service demands associated with the proposed action are relatively small, the total cumulative demands of anticipated population growth would mean there would be little excess capacity in most community services in 1985-86. Meeker and Rio Blanco County officials are aware of these development problems and are seeking assistance funds and developing new programs that, if successful, would alleviate these problems. A variety of projects that would improve Meeker schools, parks, libraries, recreation and other community facilities are being considered for funding from the Oil Shale Trust Fund (Rehburg 1981).

County Revenues. In the state of Colorado, the rate of taxation for public utilities depends on the jurisdictions crossed. Average county tax rates for 1979-80 in northwestern Colorado were as follows:

Garfield County - $80 per $1000 assessed value
Rio Blanco County - $41 per $1000 assessed value
Moffat County - $44 per $1000 assessed value
(Hirchfeld, 1981).

In Wyoming, the State Board of Equalization is responsible for assessing pipeline valuation. The Board notifies each county of the utility's assessed valuation, and the county then applies its own mil rate and bills the company according to the proportion of the facility located within the county (Sinclair and Bower, 1981).

Table 16 shows estimated county tax revenues from the proposed action in the first, fifteenth, and thirtieth years of operation. The estimates shown on Table 16 for the first year of operation represent approximately the following percentages of 1980 total county revenues.

Garfield County	-	0.3%
Rio Blanco County	-	6.9%
Moffat County	-	4.6%
Carbon County	-	1.4%
Sweetwater County	-	0.7%
Natrona County	-	0.5%

These increases in county revenues would be beneficial, but none represents a significant impact as defined, i.e., a change of 10 percent or more in county revenues (refer to Table 7).

Table 16. ESTIMATED TAX REVENUES TO AFFECTED COUNTIES DURING OPERATION OF PROPOSED ACTION (thousands of 1980 dollars)

	1st Year	15th Year	30th Year
Garfield County	$ 77.4	$ 38.7	$ 20.1
Rio Blanco County	$ 363.8	$ 181.9	$ 94.6
Moffat County	$ 295.6	$ 147.8	$ 76.9
Colorado Total	$ 736.8	$ 368.4	$ 191.6
Carbon County	$ 375.4	$ 187.7	$ 97.6
Sweetwater County	$ 45.0	$ 2.5	$ 11.7
Natrona County	$ 228.4	$ 114.2	$ 58.4
Wyoming Total	$ 648.8	$ 324.4	$ 168.7

Source: La Sal Pipe Line Company, 1981.

During operation, costs resulting from the proposed action would be negligible for all counties except Rio Blanco, where the majority of workers would reside. It is interesting to note that Rio Blanco County, which would bear most of the costs associated with operation, would also benefit from the largest percentage increase in county revenues. The estimated total per capita cost to Rio Blanco County was $1,005.87 in 1979 (BLM/REA, 1981). For an anticipated increase of 102 new residents (those directly and indirectly associated with the proposed action) this would mean a total cost to the county of $102,598.74 - compared to anticipated revenues of $363,800.00 in the first year of operation. Furthermore, the largest single source of revenues for Rio Blanco County is property taxes, to which new residents would contribute.

While the proposed action would not have a significant impact on county revenues, the cumulative effects of simultaneous developments in Rio Blanco County could be significant. Both county costs and revenues will increase rapidly. A common problem experienced by counties and municipalities in this situation is that costs often rise before revenues do, making it very difficult to finance the facilities and services needed by workers who inevitably arrive in advance of tax revenues from the project. This can be a particularly serious problem in Colorado, where counties and municipalities are limited by law to issuing bonds up to 3 percent of assessed valuation (Piatt, 1981). It is quite likely that Rio Blanco County, and Meeker, would not be able to provide all the necessary services and facilities to new residents in 1985-86 without assistance from the Oil Shale Trust Fund, or other impact assistance grants and loans.

ASSESSMENT OF ALTERNATIVES

Potential social and economic impacts for all alternatives identified would be virtually identical, with the exception of the alternative routing west of Maybell (Yampa River Alternative), and the No Action Alternative. Differences in the potential impacts of these two alternatives are outlined in the sections below.

Yampa River Alternative

Most of the potential social and economic impacts associated with this alternative are identical to those of the proposed action. The few exceptions are:

1) Less irrigated hay meadow around Maybell would be affected.

2) Nuisance factors described for the proposed action would be eliminated in Maybell, because the alternative route would be more than 5 miles from the community.

3) Local attitudes toward the project would be more positive, since many Maybell residents seem to have a strong preference for this route.

These factors would make the Yampa River Alternative slightly preferable, from a social and economic perspective, but their absence would not result in significant adverse impact.

No Action Alternative

If no pipeline is built, the significant potential social and economic impacts identified for the proposed action would not occur. On the other hand, the No Action Alternative would mean a loss of potential economic benefits to the communities and counties in the

study region. Local businesses would not experience increased sales, and counties would not receive the increased revenues that would result from construction of the proposed action.

The No Action Alternative could generate significant and adverse transportation impacts. Increasing traffic on affected road segments in northwestern Colorado is a particular concern of County Commissioners, especially in Rio Blanco County, and of the Colorado West Area Council of Governments. The Colorado West Transportation Plan assessed the impacts of a variety of methods for transporting shale oil out of northwestern Colorado, and concluded that:

> ...the impacts of <u>no</u> pipeline construction are far more severe than any of the other modal alternatives, specifically in terms of impact on pavement life, roadway capacity, and of community impacts...differences in the implementation schedules of plant development and those of the transportation links may result in hauling of products by truck during initial operations. Resulting truck volumes will be a significant problem on critical highway links and will pose major problems in the region's towns and cities.
>
> Therefore, rail and pipeline systems should be available on a schedule consistent with the timing and magnitude of energy resource develoment. This can be controlled through the permitting process.
>
> (TDA, 1980).

The effect of the No Action Alternative on regional transportation would be significant, since upgraded shale oil would have to be transported by other means from the Colony project area to refineries and markets.

In its Final Environmental Impact Statement for the proposed Colony Oil Shale Development, the Bureau of Land Management assessed the impacts of a trucking transport alternative to a proposed pipeline transportation system. Such a system would require at least 220

trucks per day, with a 9,000 gallon minimum capacity each, for the Colony Development alone (BLM, 1977). Impacts identified for this alternative included increased highway degradation, traffic congestion, traffic accidents, air emissions, and oil spills. The EIS pointed out that "present and planned highways are not designed for this high rate of use by heavy trucks," and that trucking would require more project employees, which "would increase the social and environmental impacts analyzed...by approximately ten percent." (BLM, 1977).

MITIGATION RECOMMENDATIONS

Construction Impacts

The potentially negative social and economic impacts associated with the proposed action during the construction phase would be short-term. These impacts could be avoided completely if construction contractors were to hire only local labor, but it is highly unlikely that the number of skilled workers needed for pipeline construction would be available locally at the time of construction. Impacts on community facilities and services identified for the construction phase of the proposed action could be mitigated in a number of ways:

1) The applicant could reserve existing local hotel/motel facilities well in advance of construction to ensure that local temporary accommodation will be available when it is needed, or

2) The applicant could accommodate workers in areas where housing is available, e.g., Casper, Rawlins, Battlement Mesa, or winter resort areas, and arrange an efficient means of transporting workers longer distances to worksites, or

3) The applicant could assume responsibility for providing temporary accommodation to construction workers, e.g., a self-contained camp, preferably with some entertainment and recreation facilities

Operation Impacts

Even though the anticipated operation phase workforce is small, the majority of operation workers would want to settle in Meeker, a town that will be experiencing a development "boom" over the next decade. Potential impacts could be considered significant solely

because of the cumulative demands of simultaneous developments. Accommodating the needs of even 25-40 families is difficult when community facilities and services have no excess capacity.

The La Sal Pipe Line Company could mitigate operation phase impacts by the following:

1) Ensure that local officials and planners responsible for long-range planning of community facilities and services are kept informed of anticipated workforce size and scheduled arrival.

2) Provide information and assistance, if desired, to Rio Blanco County and/or the town of Meeker, to help them prepare applications for loans and grants for needed services and facilities.

3) Work with other companies in the area to identify possible cooperative programs that could help Meeker and Rio Blanco County offset negative social and economic impacts resulting from simultaneous resource development projects.

4) Should housing for employees become such a problem that it hinders the timely construction and operation of the pipeline, identify appropriate actions that may be taken to facilitate the housing of employees and implement those programs that will effectively solve the employee housing problem.

While these mitigation measures could be taken by the applicant to alleviate adverse impacts associated with the proposed action, a much broader approach to impact mitigation in the study region is warranted due to the anticipated cumulative impacts of simultaneous major resource development projects over the next five years. Since

the proposed action is minor compared to other planned developments, however, it would not be appropriate for the applicant to initiate a comprehensive mitigation program.

MONITORING

If the Mitigation Recommendations are carried out, social and economic impacts from the proposed development would not be significant, except in that they would contribute to the cumulative effects of the rapid growth and development expected to take place in the study region in the next decade. At present, the Colorado West Area Council of Governments is working in cooperation with the State of Colorado to develop a community profile format and model for monitoring social and economic change in northwestern Colorado. The applicant should cooperate with other private developers in northwestern Colorado to ensure the success of this monitoring program (Piatt, 1981). No further, company-initiated monitoring is recommended.

APPENDIX A - CURRENT AND PROPOSED DEVELOPMENTS CONSIDERED IN POPULATION PROJECTIONS AND DESCRIPTION OF AFFECTED ENVIRONMENT

Colorado

- C-a Rio Blanco Oil Shale Project (Gulf and Standard)
- C-b Cathedral Bluffs Shale Oil Company (Occidental and Tenneco)
- Colony Oil Shale Project (Arco/Exxon and TOSCO)
- Union Oil Shale Project
- Snow Mass/Anshutz Coal
- Colowyo Coal
- Northern Minerals Coal
- New Coal (Leasing and Expansions as proposed as part of BLM's Green River - Hams Fork EIS)
- Ancillary Basic Response Development in Mesa County
- Colorado Ute Power Plant
- Utah International
- GEX/CMC Coal
- Sheridan Coal
- Energy Fuels
- Mid-Continent Mesa II
- Moon Lake (Power Plant and Coal)
- Storm King
- Multi-Minerals

Wyoming

- Arch Minerals - Medicine Bow, Seminoe #1 and #2
- Carbon County Coal Co. #1 Mine
- Energy Development Co. - strip mine, underground mine, North Knobs
- Edison Development Co. - Carbon Basin
- Gulf Oil Co. - Carbon Basin coal gasification plant
- Pathfinders Mines Corp. - Shirley Basin Mine and Mill
- Peter Kiewit & Sons - Rosebud Mine
- Petrotomics, Inc. - Shirley Basin Mine and Mill
- Carbon County Underground
- Sinclair Oil Company Refinery
- Urangesellschaft USA, Inc. - proposed mine, mill, Jenkins project
- Allied Chemical Corporation - trona mine
- Black Butte Coal Company
- Bridger Coal Company Strip Mine
- FMC Corporation - trona mine
- Minerals Exploration Company - Sweetwater Uranium Project

Pacific Power & Light - Jim Bridger Power Plant
Robert LeFaire - proposed Pumice Mine
Rocky Mountain Energy - Leucite Hills
Rocky Mountain Energy/Ideal Basic Industries Inc. - trona
Stauffer Chemical Company of Wyoming - trona
Tenneco, Inc. - trona
Texasgulf, Inc. - trona
U.S. Department of Energy - oil shale in situ experiment
AMOCO Oil Company refinery
Benton Clay Corporation - Bentonite Mine
Kaycee Bentonite Corporation - Kaycee Mine
Little America Refining Company - Little America Refinery
Rocky Mountain Energy - Nine Mile Lake
Texaco, Inc. - refinery
Union Carbide Corporation - Gas Hills Operation

APPENDIX B - PROJECTED SUPPLY OF RENTAL HOUSING IN CASPER, 1981-84.

Table B-1. EXCESS OR (SHORTAGE) IN SUPPLY OF RENTAL SINGLE FAMILY HOUSING, 1980 - 1984, CASPER, WYOMING (NUMBER OF UNITS)

Monthly Housing Expenditure	Net Supply (Demand) 1980	Annual Projected Housing Demand Excess or (Shortage)			
		1981	1982	1983	1984
Less than $149	44	41	38	35	32
$150 - $249	134	125	116	107	98
$250 - $349	143	128	113	98	83
$350 - $449	414	400	386	372	358
$450 - $549	98	91	84	77	70
Over $550	(113)	(125)	(137)	(149)	(161)
TOTAL	720	660	600	540	480

Source: Mobius and Stuart/Nichols, 1980, p. F30.

Table B-2. EXCESS OR (SHORTAGE) IN SUPPLY OF RENTAL MULTI-FAMILY HOUSING*, 1980 - 1984, CAPSER, WYOMING (NUMBER OF UNITS)

Monthly Housing Expenditure	Net Supply (Demand) 1980	Annual Projected Housing Demand Excess or (Shortage)			
		1981	1982	1983	1984
Less than $149	(44)	(60)	(76)	(92)	(108)
$150 - $249	544	533	512	491	470
$250 - $349	1076	1063	1050	1037	1024
$350 - $449	956	937	918	899	880
$450 - $549	46	44	42	40	38
Over $550	--	(9)	(18)	(27)	(36)
TOTAL	2588	2508	2428	2348	2268

*Multi-family housing includes duplexes, triplexes, fourplexes, and apartments but not townhouses or condominiums.

Source: Mobius and Stuart/Nichols, 1980, p. F32.

Table B-3. EXCESS OR (SHORTAGE) IN SUPPLY OF RENTAL MOBILE HOMES, 1980 - 1984, CASPER, WYOMING (NUMBER OF UNITS)

Monthly Housing Expenditure	Net Supply (Demand) 1980	Annual Projected Housing Demand Excess or (Shortage)			
		1981	1982	1983	1984
Less than $149	43	43	43	43	43
$150 - $249	44	42	40	38	36
$250 - $349	87	87	87	87	87
$350 - $449	1	1	1	1	1
$450 - $549	43	42	41	40	39
Over $550	(43)	(46)	(49)	(52)	(55)
TOTAL	175	169	196	157	151

Source: Mobius and Stuart/Nichols, 1980, p. F34.

APPENDIX C - CONSULTATION/COORDINATION

Information obtained through BLM's formal Scoping Process has been used in the preparation of this document. In addition, information was obtained from a wide variety of government agencies and individuals. Agencies contacted are listed below. See Appendix D for a list of individuals and secondary sources consulted.

AGENCIES CONTACTED

Baggs, Wyoming
- Town Clerk's Office

Bureau of Labor Statistics
- San Francisco, CA

Carbon County
- Office of the County Treasurer
- County Planning Office

Chamber of Commerce
- Casper, Wyoming
- Craig, Colorado
- Meeker, Colorado
- Rawlins, Wyoming

Colorado
- Bureau of Economic Analysis
- Department of Local Affairs
- Department of Natural Resources
- Regional Economics Information System
- State Highway Department

Department of Local Affairs
- Division of Local Government
- Division of Planning
  - Demographic Section
  - Energy Impact Office
- Division of Property Taxation

Department of Natural Resources
- Joint Review Office

Department of Revenue

Division of Employment and Training
    Labor Market Information Branch

Public Utilities Appraiser

Colorado West Area Council of Governments

Department of Commerce
    Bureau of the Census

Department of the Interior

    Bureau of Land Management
        Colorado State Office
            Little Snake Resource Area
            White River Resource Area
        Wyoming State Office
            Casper District
            Rawlins District

    Water and Power Resources Service
        Casper, WY

Garfield County
    County Treasurer

Meeker, Colorado
    Meeker Chamber of Commerce

Moffat County
    Clerk's Office
    Planning Office
    Planning Commission

Parachute, Colorado
    City Clerk's Office

Natrona County
    Office of the County Treasurer

Rawlins, Wyoming
    City Planning Office

Rifle, Colorado
    Office of City Government

Rio Blanco County
    County Planning Office

Sweetwater County
    County Clerk's Office

Universities and Colleges
    University of Wyoming, Laramie, WY
    University of Colorado, Boulder, CO

Wyoming
    Board of Equalization

    Department of Administration and Fiscal Control,
      Division of Research and Statistics

    Department of Economic Planning and Development

    Department of Environmental Quality

    Employment Security Commission
      Research and Analysis Section

    Highway Department

    Industrial Siting Council

    State Planning Agency
      A-95 Clearing House

    Wyoming Retail Merchants Association

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LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

SOILS AND PRIME AGRICULTURE BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL

SOILS AND PRIME AGRICULTURE BACKGROUND REPORT

AFFECTED ENVIRONMENT

Soils

Proposed Trunkline. The proposed trunkline route is primarily within the Central Desertic Basins, Mountains, and Plateaus portion of the Western Range and Irrigated Region (U.S. Soil Conservation Service [SCS] 1978). Annual precipitation generally ranges from 7 to 23 inches along the proposed trunkline route, but the majority of the route is within the 8 to 14 inch precipitation zone. Forty-six different soil phases, series, associations, or great groups were identified along the proposed trunkline. Table 1 lists (by mileposts) and characterizes the identified soils.

The soils identified along the proposed trunkline route can be generally grouped into two main categories according to their physiographic location: 1) alluvial soils; and 2) upland soils. The alluvial soils are primarily deep, well to somewhat poorly drained, fine sandy loam, loamy sand, loam, silt loam, silty clay loam, and clay loam soils. These soils are forming in alluvium derived primarily from sedimentary rocks on alluvial fans, terraces, benches, floodplains, drainageways, valley bottomlands, and toeslopes. The terrain slopes range mainly from nearly level to moderately sloping.

Table 1. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG THE PROPOSED TRUNKLINE

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Garfield County, Colorado[1]						
0.0 - 0.1	6CF	Irigul: Shallow, well drained, channery loam soil formed in residuum from sandstone and marlstone on moderately sloping to steep upland ridges and mountainsides.	Irigul*	10 - 20	9 - 50	Underlain by extremely channery material, water erosion hazard is moderate, topsoil is poor. Capability class VIIe, 20 inch precipitation zone.
0.1 - 0.3	2CE/3F	Parachute-Rhone: Moderately deep to deep, well drained, loam soils formed in residuum from sandstone and marlstone on gently sloping to very steep ridges and mountainsides.	Parachute* Rhone	20 - 40 40 - 60	5 - 30 5 - 70	Underlain by sandy clay loam and channery sandy clay loam, water erosion hazard is moderate, topsoil is fair to poor. Capability classes VIe and VIIe, 20 inch precipitation zone.
0.3 - 0.45	6CF	Irigul: Shallow, well drained, channery loam soil formed in residuum from sandstone and marlstone on moderately sloping to steep upland ridges and mountainsides.	Irigul*	10 - 20	9 - 50	Underlain by extremely channery material, water erosion hazard is moderate, topsoil is poor. Capability class VIIe, 20 inch precipitation zone.
0.45 - 0.65	2CE/3F	Parachute-Rhone: Moderately deep to deep, well drained, loam soils formed in residuum from sandstone and marlstone on gently sloping to very steep ridges and mountainsides.	Parachute* Rhone	20 - 40 40 - 60	5 - 30 5 - 70	Underlain by sandy clay loam and channery sandy clay loam, water erosion hazard is moderate, topsoil is fair to poor. Capability classes VIe and VIIe, 20 inch precipitation zone.
0.65 - 0.8	6CF	Irigul: Shallow, well drained, channery loam soil formed in residuum from sandstone and marlstone on moderately sloping to steep upland ridges and mountainsides.	Irigul*	10 - 20	9 - 50	Underlain by extremely channery material, water erosion hazard is moderate, topsoil is poor. Capability class VIIe, 20 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Garfield County, Colorado[1] (continued)						
0.8 - 2.0	2CE/3F/1F	Parachute-Rhone: Moderately deep to deep, well drained, loam soils formed in residuum from sandstone and marlstone on gently sloping to very steep ridges and mountain-sides.	Parachute* Rhone	20 - 40 40 - 60	5 - 65 5 - 70	Underlain by sandy clay loam, channery sandy clay loam, and very channery loam. Water erosion hazard is moderate, and topsoil is fair to poor. Capability classes VIe and VIIe, 20 inch precipitation zone.
2.0 - 2.2	5EF	Northwater: Deep, well drained, loam soil formed in residuum from sedimentary rocks on strongly sloping to very steep mountainsides.	Nortbwater	40 - 60	15 - 65	Subsoil is very channery, water erosion hazard is moderate, and topsoil is poor. Capability class VIIe, 20 inch precipitation zone.
2.2 - 2.6	2CE	Parachute-Rhone: Moderately deep to deep, well drained, loam soils formed in residuum from sandstone and marlstone on gently sloping to moderately steep ridge crests and mountainsides.	Parachute* Rhone	20 - 40 40 - 60	5 - 30 5 - 9	Underlain by sandy clay loam and channery sandy clay loam, water erosion hazard is moderate, and topsoil is fair. Capability class VIe, 20 inch precipitation zone.
2.6 - 3.0	5EF	Northwater: Deep, well drained, loam soil formed in residuum from sedimentary rocks on strongly sloping to very steep mountainsides.	Northwater	40 - 60	15 - 65	Subsoil is very channery, water erosion hazard is moderate, and topsoil is poor. Capability class VIIe, 20 inch precipitation zone.
3.0 - 3.1	2CE	Parachute-Rhone: Moderately deep to deep, well drained, loam soils formed in residuum from sandstone and marlstone on gently sloping to moderately steep ridge crests and mountainsides.	Parachute* Rhone	20 - 40 40 - 60	5 - 30 5 - 9	Underlain by sandy clay loam and channery sandy clay loam, water erosion hazard is moderate, and topsoil is fair. Capability class VIe, 20 inch precipitation zone.
3.1 - 3.4	3F	Rhone: Deep, well drained, loam soil formed in residuum from sandstone and marlstone on steep to very steep mountainsides and ridges.	Rhone	40 - 60	30 - 70	Underlain by sandy clay loam and channery sandy clay loam, water erosion hazard is moderate, and topsoil is poor. Capability class VIIe, 20 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Garfield County, Colorado[1] (continued)						
3.4 - 3.6	6CF	Irigul: Shallow, well drained, channery loam soil formed in residuum from sandstone and marlstone on moderately sloping to steep upland ridges and mountainsides.	Irigul*	10 - 20	9 - 50	Underlain by extremely channery material, water erosion hazard is moderate, topsoil is poor. Capability class VIIe, 20 inch precipitation zone.
3.6 - 6.0	2CE	Parachute-Rhone: Moderately deep to deep, well drained, loam soils formed in residuum from sandstone and marlstone on gently sloping to moderately steep ridge crests and mountainsides.	Parachute* Rhone	20 - 40 40 - 60	5 - 30 5 - 9	Underlain by sandy clay loam and channery sandy clay loam, water erosion hazard is moderate, and topsoil is fair. Capability class VIe, 20 inch precipitation zone.
Rio Blanco County, Colorado[2]						
6.0 - 7.25	11	Irigul-Parachute-Rhone: Shallow to deep, well drained, channery loam and loam soils formed in residuum and colluvium derived from sandstone and marlstone on moderately sloping to very steep ridges, sideslopes, and mountainsides.	Irigul* Parachute* Rhone	10 - 20 20 - 40 40 - 60	5 - 75 5 - 65 5 - 30	Underlain by unweathered bedrock (sandstone and marlstone) and channery loams, moderate water erosion hazard, poor to fair topsoil, 18-23 inch precipitation zone.
7.25 - 9.25	9	Castner-Veatch-Redcreek: Shallow and moderately deep, well to somewhat excessively drained, channery, channery loams, and sandy loam soils formed in residuum and colluvium (derived from sedimentary rocks) on uplands, mountain sideslopes, and ridgetops; and from aeolian deposits and residuum (derived from sandstone) on uplands and ridgetops.	Castner* Veatch* Redcreek*	10 - 20 20 - 40 10 - 20	5 - 45 10 - 50 5 - 30	Underlain by sandstone or marlstone bedrock, moderate to high water erosion hazard, poor topsoil, 14-18 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
<u>Rio Blanco County, Colorado</u>[2] (continued)						
9.25 - 12.75	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
12.75 - 16.25	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali effected, and the Kobar-Havre portion is generally calcareous throughout.
16.25 - 19.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[2] (continued)						
19.5 - 21.25	9	Castner-Veatch-Redcreek: Shallow and moderately deep, well to somewhat excessively drained, channery, channery loams, and sandy loam soils formed in residuum and colluvium (derived from sedimentary rocks) on uplands, mountain sideslopes, and ridgetops; and from aeolian deposits and residuum (derived from sandstone) on uplands and ridgetops.	Castner* Veatch* Redcreek*	10 - 20 20 - 40 10 - 20	5 - 45 10 - 50 5 - 30	Underlain by sandstone or marlstone bedrock, moderate to high water erosion hazard, poor topsoil, 14-18 inch precipitation zone.
21.25 - 22.0	11	Irigul-Parachute-Rhone: Shallow to deep, well drained, channery loam and loam soils formed in residuum and colluvium derived from sandstone and marlstone on moderately sloping to very steep ridges, sideslopes, and mountainsides.	Irigul* Parachute* Rhone	10 - 20 20 - 40 40 - 60	5 - 75 5 - 65 5 - 30	Underlain by unweathered bedrock (sandstone and marlstone) and channery loams, moderate water erosion hazard, poor to fair topsoil, 18-23 inch precipitation zone.
22.0 - 23.75	9	Castner-Veatch-Redcreek: Shallow and moderately deep, well to somewhat excessively drained, channery, channery loams, and sandy loam soils formed in residuum and colluvium (derived from sedimentary rocks) on uplands, mountain sideslopes, and ridgetops; and from aeolian deposits and residuum (derived from sandstone) on uplands and ridgetops.	Castner* Veatch* Redcreek*	10 - 20 20 - 40 10 - 20	5 - 45 10 - 50 5 - 30	Underlain by sandstone or marlstone bedrock, moderate to high water erosion hazard, poor topsoil, 14-18 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[2] (continued)						
23.75 - 24.75	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout.
24.75 - 25.25	9	Castner-Veatch-Redcreek: Shallow and moderately deep, well to somewhat excessively drained, channery, channery loams, and sandy loam soils formed in residuum and colluvium (derived from sedimentary rocks) on uplands, mountain sideslopes, and ridgetops; and from aeolian deposits and residuum (derived from sandstone) on uplands and ridgetops.	Castner* Veatch* Redcreek*	10 - 20 20 - 40 10 - 20	5 - 45 10 - 50 5 - 30	Underlain by sandstone or marlstone bedrock, moderate to high water erosion hazard, poor topsoil, 14-18 inch precipitation zone.
25.25 - 28.75	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[2] (continued)						
28.75 - 29.5	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout
29.5 - 30.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
30.25 - 32.75	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout
32.75 - 37.0	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[2] (continued)						
37.0 - 37.75	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout.
37.75 - 39.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
39.25 - 40.25	7	Forelle-Zoltay-Work: Deep, well drained, fine sandy loam, gravelly clay loam, and clay loam soils formed in aeolian deposits, alluvium, and colluvium on nearly level to moderately steep uplands, terraces, benches, fans, and valley side-slopes.	Forelle Zoltay Work	60+ 60+ 60+	1 - 25 2 - 25 1 - 25	Underlain by loamy, gravelly-cobbly clay, and gravelly clay loam materals, water erosion hazard is slight to moderate, topsoil is primarily poor to fair, 15-18 inch precipitation zone.
40.25 - 46.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[2] (continued)						
46.25 - 46.75	4	Chipeta-Killpack: Shallow and moderataly deep, well drained, silty clay loam and clay loam soils formed in residiuum from gypsiferous shale on nearly level to moderately steep low hills and ridges.	Chipeta* Killpack	10 - 20 20 - 40	1 - 25 1 - 12	Overlies weathered shale bedrock, water erosion hazard is high, topsoil is poor to fair, 8-10 inch precipitation zona. These soils are moderataly to strongly salt and alkali affected.
Moffat County, Colorado[3,4]						
46.75 - 47.25	1	Pinelli-Kemmerar-Forelle: Deep and moderataly deep, well drained, loam and silty clay loam soils forming in calcareous aeolian and mixed materials weathered from shale and sandstone on gently sloping to moderately steep upland ridges, drainageways and hills.	Pinelli Kemmerer Forelle	60+ 20 - 40 60+	2 - 30 2 - 30 2 - 30	Subsoils are clay loams and silty clay loams, moderate water erosion hazard, topsoil is primarily fair to poor, 10-14 inch precipitation zone. Pinalli-Kemmerer portion has high shrink-swell potential to a depth of 2 feet.
47.25 - 47.75	4	Havre-Absher-Cumulic Haplaquolls: Deep, well to poorly drained, loamy and fina sandy loam soils forming in alluvium on nearly level to gently sloping drainage-ways, floodplains, and stream terraces.	Havre Absher*	60+ 60+	0 - 4 0 - 6	Subsoils are stratified loams and silty clays, moderate to high water erosion hazard, topsoil is good to poor, 10-15 inch precipitation zone. Absher portion is highly alkaline (excess salts) and has high shrink-swell potential.
47.75 - 55.0	1	Pinelli-Kemmerer-Forelle: Deep and moderately deep, well drained, loam and silty clay loam soils forming in calcareous aeolian and mixed materials weathered from shale and sandstona on gently sloping to moderataly steep upland ridges, drainageways and hills.	Pinelli Kemmerer Forelle	60+ 20 - 40 60+	2 - 30 2 - 30 2 - 30	Subsoils are clay loams and silty clay loams, moderate water erosion hazard, topsoil is primarily fair to poor, 10-14 inch precipitation zone. Pinelli-Kemmarer portion has high shrink-swell potential to a depth of 2 feet.
55.0 - 55.5	5	Rentsac-Crestman-Rock Outcrop: Shallow, well and excessively drained, channery loam and loamy sand soils formed in materials weathered from sandstone on moderately sloping to steep upland ridges, mountains, sideslopes, and breaks.	Rentsac* Crestman*	10 - 20 10 - 20	5 - 45 5 - 50	Underlain by sandstone, moderate water erosion hazard, Crestman portion has high wind erosion hazard, topsoil is poor, 7-14 inch precipitation zone. Includes areas of sandstone rock outcrops.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Moffat County, Colorado[3,4] (continued)						
55.5 - 56.25	1	Pinelli-Kemmerer-Forelle: Deep and moderately deep, well drained, loam and silty clay loam soils forming in calcareous aeolian and mixed materials weathered from shale and sandstone on gently sloping to moderately steep upland ridges, drainageways and hills.	Pinelli Kemmerer Forelle	60+ 20 - 40 60+	2 - 30 2 - 30 2 - 30	Subsoils are clay loams and silty clay loams, moderate water erosion hazard, topsoil is primarily fair to poor, 10-14 inch precipitation zone. Pinelli-Kemmerer portion has high shrink-swell potential to a depth of 2 feet.
56.25 - 57.0	2	Regent-Work: Moderately deep to deep, well drained, silty clay loam and clay loam soils forming in alluvium and residuum from shale on gently sloping to moderately steep upland benches and mountainsides.	Regent Work	20 - 60 60+	2 - 9 2 - 30	Underlain by silty clay loam and gravelly clay loam subsoils, moderate water erosion hazard, fair to poor topsoil, 14-17 inch precipitation zone, high to moderate shrink-swell potential. Includes areas of rock outcrop on the steeper mountain slopes and ridge sideslopes.
57.0 - 58.5	7	Evanston-Rock River-Grieves: Deep, well drained, loam, sandy loam, and loamy sand soils forming in alluvium on nearly level to very steep hillsides, ridges, and fans.	Evanston Rock River Grieves	60+ 60+ 60+	0 - 25 0 - 65 10 - 40	Underlain by clay loam, sandy clay loam, and sandy loam subsoils, moderate to low water erosion hazard, Grieves portion is highly susceptible to wind erosion, topsoil is primarily fair to poor, 10-15 inch precipitation zone.
58.5 - 70.25	14	Zeona-Ryan Park-Rock River: Deep, excessively to well drained, loamy sand, loamy fine sand, and sandy loam soils formed in aeolian deposits and alluvium on primarily gently sloping to strongly sloping hills, mesas, alluvial fans, and toe slopes.	Zeona Ryan Park Rock River	60+ 60+ 60+	5 - 30 2 - 12 0 - 65	Underlain by sandstone bedrock, low to moderate water erosion hazard, Zeona-Ryan Park portion is highly susceptible to wind erosion, primarily poor to fair topsoil, 10-14 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Moffat County, Colorado[3,4] (continued)						
70.25 - 71.0	7	Evanston-Rock River-Grieves: Deep, well drained, loam, sandy loam, and loamy sand soils forming in alluvium on nearly level to very steep hillsides, ridges, and fans.	Evanston Rock River Grieves	60+ 60+ 60+	0 - 25 0 - 65 10 - 40	Underlain by clay loam, sandy clay loam, and sandy loam subsoils, moderate to low water erosion hazard, Grieves portion is highly susceptible to wind erosion, topsoil is primarily fair to poor, 10-15 inch precipitation zone.
71.25 - 74.25	14	Zeona-Ryan Park-Rock River: Deep, excessively to well drained, loamy sand, loamy fine sand, and sandy loam soils formed in aeolian deposits and alluvium on primarily gently sloping to strongly sloping hills, mesas, alluvial fans, and toe slopes.	Zeona Ryan Park Rock River	60+ 60+ 60+	5 - 30 2 - 12 0 - 65	Underlain by sandstone bedrock, low to moderate water erosion hazard, Zeona-Ryan Park portion is highly susceptible to wind erosion, primarily poor to fair topsoil, 10-14 inch procipitation zone.
74.25 - 76.0	5	Rentsac-Crestman-Rock Outcrop: Shallow, well and excessively drained, channery loam and loamy sand soils formed in materials weathered from sandstone on moderately sloping to steep upland ridges, mountains, sideslopes, and breaks.	Rentsac* Crestman*	10 - 20 10 - 20	5 - 45 5 - 50	Underlain by sandstone, moderate water erosion hazard, Crestman portion has high wind erosion hazard, topsoil is poor, 7-14 inch precipitation zone. Includes areas of sandstone rock outcrops.
76.0 - 93.75	10	Relsob-Zeona-Rock River: Deep, well and somewhat excessively drained, loamy sand, and sandy loam soils formed in mixed alluvium and residuum (weathered primarily from sandstone) on gently to strongly sloping ridges, hillsides, and benches.	Relsob Zeona Rock River	60+ 60+ 60+	3 - 15 5 - 30 0 - 65	Underlain by sandy clay loam, and loamy sand subsoils, low to moderate water erosion hazard, Zeona portion is highly susceptible to wind erosion, primarily fair to poor topsoil, 10-14 inch precipitation zone.
93.75 - 107.0	35	Ustic Torriorthents-Aridic Argiborolls: Deep and shallow, well drained, loamy and clayey soils formed primarily from weathered sandstone and shale on nearly level to strongly sloping uplands, valley sideslopes, and alluvial fans.	———	10 - 60+	0 - 15	Underlain by sandstone and shale, slow permeability and moderate to high shrink-swell potential on the clayey portions, 10-15 inch precipitation zone. Includes rock fragments and gravel.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Moffat County, Colorado[3,4] (contioued)						
107.0 - 110.75	34	Ustic Torriorthents-Borollic Camborthids: Moderately deep and deep, well drained, loamy soils formed primarily in mixed alluvium and old outwash materiels on gently slopiog to moderately steep fans and floodplains.	———	20 - 60+	2 - 30	Ustic Torriothents portion is commonly calcareous throughout and permeability is moderate to moderately rapid. Borollic Camborthids portion has slow to moderate permeability.
Carbon County, Wyoming[5] (Part I)						
110.75 - 111.0	BF-5	Torrifluvents-Fluvaquents-Halaquepts: Deep, well to somewhat poorly drained, fine-loamy soils forming in alluvium on nearly level to gently sloping floodplains and stream terraces.	———	60+	0 - 6	Underlain by sandstone, clay shale, and marlstone bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, 8-14 inch precipitation zone. Ustic Halaquepts portion contains salts.
111.0 - 153.75	BF-13	Torriorthents-Camborthids-Haplargids: Deep, moderately well drained, fine-loamy soils forming primarily in alluvium and residuum on nearly level playas to strongly sloping uplands.	———	60+	0 - 15	Underlain by sandstone and clay shale bedrock, moderate to <u>high</u> water erosion hazard, low wind erosion hazard, 8-14 inch precipitation zone.
153.75 - 155.25	MC-8	Cryoborolls-Cryorthents: Shallow to deep, moderately well to poorly drained, loamy (skeletal) and to a lesser extent clayey soils forming in residuum and transported materials (from sedimentary bedrocks) on moderately sloping to steep mountains and mountain valleys.	———	10 - 60+	5 - 60	Underlain by sandstone and clay shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, 10-14 inch precipitation zone.
155.25 - 164.25	BF-10	Torriorthents-Haplargids-Natrargids: Shallow to deep, well to poorly drained, loamy (fine and coarse) soils forming in residuum from sandstone and clay shales on gently sloping to moderately steep uplands.	———	10 - 60+	3 - 20	Underlain by sandstone and clay shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, 8-14 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Sweetwater County, Wyoming[6]						
164.25 - 165.75	A2	Grieves-Almy: Deep, well drained, fine sandy loam soils forming in alluvium and residuum derived from sandstone and interbedded shale on gently sloping to moderately sloping on alluvial fans and toeslopes.	Grieves Almy	60+ 60+	2 - 9 2 - 9	Almy portion has clay loam subsoils, water and wind erosion hazards are moderate, good to poor topsoil, 10-12 inch precipitation zone.
165.75 - 180.8	A1	Battlespring-Graypoint: Deep and moderately deep, well drained, sandy loam and gravelly sandy loam soils forming in alluvium and residuum on nearly level to moderately sloping alluvial fans, valley, and upland plains.	Battlespring Graypoint	60+ 60+	0 - 6 0 - 6	Underlain by loamy sand and very gravelly sand, moderate wind and water erosion hazard, fair to poor topsoil (salts, thin-stoney), 7-9 inch preciptation zone.
Carbon County, Wyoming[5] (Part II)						
180.8 - 199.5	BF-6	Torriorthents (alkali): Deep, poorly drained, fine textured soils developing in alluvium on nearly level to moderately sloping floodplains, playas, and upland drainageways.	______	60+	0 - 6	Underlain by sandstone and clay shale bedrock, modarate wind and water erosion hazard, 8-14 inch precipitation zone. Soils are strongly to very strongly alkali affected.
199.5 - 215.0	BF-1	Torripsamments: Deep, well drained, sandy soils forming in aeolian sand on gently to strongly sloping intermountain basins and foothills.	______	60+	2 - 20	Includes dune areas, low water erosion hazard, high wind erosion hazard, 8-14 inch precipitation zone. Dune areas are difficult to stabilize and reclaim.
215.0 - 219.0	MF-3	Haploborolls-Argiborolls-Rock Outcrop: Shallow, moderately deep, and deep, poorly to moderately well drained, loamy and fine textured soils developing in residuum and transported materials (from sedimentary bedrocks) on moderately sloping to steep mountainsides, valleys, and foothills.	______	10 - 60+	5 - 40	Underlain by sedimentary bedrock, moderate water erosion hazard, low wiud erosion hazard, 10-19 inch precipitation zone. Includes rock outcrop areas.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
<u>Carbon County, Wyoming</u>[5] (Part II) (continued)						
219.0 - 229.25	BF-8	Torriorthents-Haplargids-Natrargids: Shallow to very deep, moderately well to poorly drained, loamy (coarse to fine) soils developing in residuum from soft, calcareous sandstone on gently to moderately sloping portions of the Sweetwater Plateau.	———	10 - 60+	3 - 8	Underlain by sedimentary bedrock and granite, moderate wind and erosion hazard, 8-14 inch precipitation zone. Includes granite rock outcrops.
<u>Natrona County, Wyoming</u>[7,8]						
229.25 - 238.75	BF-8	Torriorthents-Haplargids-Natrargids: Shallow to very deep, moderately well to poorly drained, loamy (coarse to fine) soils developing in residuum from soft, calcareous sandstone on gently to moderately sloping portions of the Sweetwater Plateau.	———	10 - 60+	3 - 8	Underlain by sedimentary bedrock and granite, moderate wind and erosion hazard, 8-14 inch precipitation zone. Includes granite rock outcrops.
238.75 - 239.25	380	Yamac-Ladner: Deep, well drained, fine sandy loam, loam, sandy loam, and loamy fine sand soils forming in transported materials on nearly level to gently sloping low stream terraces.	Yamac Ladner	60+ 60+	0 - 5 0 - 5	Underlain by sedimentary bedrock, low to moderate water erosion hazard, wind erosion hazard is moderate to <u>high</u>, 10-14 inch precipitation zone. Yamac portion has a highly calcareous layer below 10 inches (5 inch surface layer). Ladner portion has a sodic layer below 2 inch surface layer.
239.25 - 240.75	375	Ryan Park: Deep, well drained, loamy sand soils formed in transported materials on nearly level to gently sloping stream terraces.	Ryan Park	60+	0 - 4	Underlain by gravelly and sandy substrata, moderate water erosion hazard, moderate <u>to high</u> wind erosion hazard, fair topsoil, 10-14 inch precipitation zone.
240.75 - 243.25	376	Archin-Ryan Park: Deep, well drained, sandy loam and loamy sand soils forming in alluvium and residuum on gently sloping stream terraces.	Archin Ryan Park	60+ 60+	2 - 6 2 - 6	Underlain by gravelly and sandy substrata, moderate water erosion hazard, moderate <u>to high</u> wind erosion hazard, 10-14 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Natrona County, Wyoming[7,8] (continued)						
243.25 - 244.75	380	Yamac-Ladner: Deep, well drained, fine sandy loam, loam, sandy loam, and loamy fine sand soils forming in transported materials on nearly level to gently sloping low stream terraces.	Yamac Ladner	60+ 60+	0 - 5 0 - 5	Underlain by sedimentary bedrock, low to moderate water erosion hazard, wind erosion hazard is moderate to high, 10-14 inch precipitation zone. Yamac portion has a highly calcareous layer below 10 inches (5 inch surface layer). Ladner portion has a sodic layer below 2 inch surface layer.
244.75 - 247.25	375C	Ryan Park-Zeona: Deep, well to excessively drained, loamy sand soils forming in alluvium, residuum, and aeolian deposits on moderately sloping stream terraces, mounds, and smooth ridges.	Ryan Park Zeona	60+ 60+	6 - 10 6 - 15	Underlain by gravelly and sandy substrata, low to moderate water erosion hazard, high wind erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone.
247.25 - 247.75	380	Yamac-Ladner: Deep, well drained, fine sandy loam, loam, sandy loam, and loamy fine sand soils forming in transported materials on nearly level to gently sloping low stream terraces.	Yamac Ladner	60+ 60+	0 - 5 0 - 5	Underlain by sedimentary bedrock, low to moderate water erosion hazard, wind erosion hazard is moderate to high, 10-14 inch precipitation zone. Yamac portion has a highly calcareous layer below 10 inches (5 inch surface layer). Ladner portion has a sodic layer below 2 inch surface layer.
247.75 - 248.25	425	Yampa: Deep, well to somewhat poorly drained, loamy and clay loam soils forming in transported and residual materials in wet swales, drains, and alluvial areas.	Yampa	60+	0 - 4	Sandy gravel with free water below 36 inches in some areas, moderate water erosion hazard, 10-14 inch precipitation zone.
248.25 - 248.75	388	Forelle: Deep, well drained, loam, sandy loam, and fine sandy loam soils forming in transported materials (alluvium) on gently sloping to moderately sloping terraces, fans, and sideslopes.	Forelle	60+	2 - 9	Loamy and clay loam subsoils, moderate wind and water erosion hazard, 10-14 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Natrona County, Wyoming[7,8] (continued)						
248.75 - 249.0	425	Yampa: Deep, well to somewhat poorly drained, loamy and clay loam soils forming in transported and residual materials in wet swales, drains, and alluvial areas.	Yampa	60+	0 - 4	Sandy gravel with free water below 36 inches in some areas, moderate water erosion hazard, 10-14 inch precipitation zone.
249.0 - 250.0	388	Forelle: Deep, well drained, loam, sandy loam, and fine sandy loam soils forming in transported materials (alluvium) on gently sloping to moderately sloping terraces, fans, and sideslopes.	Forelle	60+	2 - 9	Loamy and clay loam subsoils, moderate wind and water erosion hazard, 10-14 inch precipitation zone.
250.0 - 250.5	425	Yampa: Deep, well to somewhat poorly drained, loamy and clay loam soils forming in transported and residual materials in wet swales, drains, and alluvial areas.	Yampa	60+	0 - 4	Sandy gravel with free water below 36 inches in some areas, moderate water erosion hazard, 10-14 inch precipitation zone.
250.5 - 252.0	381C	Boaler-Alcova: Deep, well and moderately well drained, fine sandy loam, loam, and loamy sand soils forming in transported materials on moderately to strongly sloping stream terraces.	Boaler Alcova	60+ 60+	6 - 15 6 - 15	Underlain by loamy sand, cobbly loamy sand, and gravelly loamy sand substrata, moderate wind and water erosion hazard, 10-14 inch precipitation zone.
252.0 - 255.25	437	Worfman: Shallow to moderately deep, somewhat poorly to moderately well drained, sandy loam and loam soils forming in transported materials and residuum on sideslopes, and stream terraces.	Worfman	10 - 40	10 - 60	Paralithic sandstone bedrock at a depth of 12 inches in some areas, moderate wind and water erosion hazard, 10-14 inch precipitation zone. Note: slope range is much too high for actual proposed pipeline route.
255.25 - 256.0	203	Cushman-Fort Collins: Moderately deep to deep, well drained, loam and very fine sandy loam soils forming in residuum (siltstone) and alluvium on gently to strongly sloping sideslopes and alluvial fans.	Cushman Fort Collins	20 - 40 60+	6 - 15 3 - 6	Cushman portion overlies soft siltstone, moderate water erosion hazard, low wind erosion hazard, 10-14 inch precipitation zone.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Natrona County, Wyoming[7,8] (continued)						
256.0 - 259.25	234	Fort Collins-Zigweid: Deep, well drained, sandy loam, loam, and silt loam soils formed in alluvium derived from soft sandstone (some calcareous) on gently sloping to moderately steep alluvial fans and footslopes.	Fort Collins Zigweid	60+ 60+	3 - 15 6 - 25	Underlain by sandy clay, loam, and clay loam subsoils, moderate water erosion hazard, low wind erosion hazard, 9-14 inch precipitation zone.
259.25 - 261.75	410	Abated-Bone: Deep, moderately well drained, loam, clay loam, sandy clay loam, and silt loam soils forming in alluvium on nearly level to gently sloping floodplains, stream terraces, and fans.	Abstaed Bone	60+ 60+	0 - 3 0 - 3	Clay loam, loam, and silty clay subsoils, moderate water erosion hazard, 10-14 inch precipitation zone.
261.75 - 262.75	402	Thedalund-Shingle-Kim: Shallow to deep, moderately well to somewhat poorly drained, clay loam soils forming in residuum and alluvium on gently sloping to steep ridges, sideslopes, and alluvial fans.	Thedalund Shingle Kim	20 - 40 10 - 20 60+	10 - 45 4 - 25 10 - 30	Thedalund-Shingle portion overlies silty-sandy shale, in some areas surface texture is stony, cobbly, or gravelly, moderate wind and water erosion hazard, 10-14 inch precipitation zone. Note: slope range is too high for actual proposed pipeline route.
262.75 - 263.0	234	Fort Collins-Zigweid: Deep, well drained, sandy loam, loam, and silt loam soils formed in alluvium derived from soft sandstone (some calcareous) on gently sloping to moderately steep alluvial fans and footslopes.	Fort Collins Zigweid	60+ 60+	3 - 15 6 - 25	Underlain by sandy clay, loam, and clay loam subsoils, moderate water erosion hazard, low wind erosion hazard, 9-14 inch precipitation zone.
263.0 - 263.75	402	Thedalund-Shingle-Kim: Shallow to deep, moderately well to somewhat poorly drained, clay loam soils forming in residuum and alluvium on gently sloping to steep ridges, sidealopes, and alluvial fans.	Thedalund Shingle Kim	20 - 40 10 - 20 60+	10 - 45 4 - 25 10 - 30	Thedalund-Shingle portion overlies silty-saudy shale, in some areas surface texture is stony, cobbly, or gravelly, moderate wind and water erosion hazard, 10-14 inch precipitation zone. Note: slope range is too high for actual proposed pipeline route.

Table 1. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Natrona County, Wyoming[7,8] (continued)						
263.75 - 265.25	410	Abated-Bone: Deep, moderately well drained, loam, clay loam, sandy clay loam, and silt loam soils forming in alluvium on nearly level to gently sloping flood-plains, stream terraces, and fans.	Abtsed Bone	60+ 60+	0 - 3 0 - 3	Clay loam, loam, and silty clay subsoils, moderate water erosion hazard, 10-14 inch precipitation zone.
265.25 - 266.25	252	Stoneham-Zigweid: Deep, well and moder-ately well drained, sandy loam and loam soils formed from transported and residual materials on moderately sloping to strongly sloping upland sideslopes.	Stoneham Zigweid	60+ 60+	5 - 15 5 - 15	Underlain by clay shale bedrock, low to moderate wind and water erosion hazard, 10-14 inch precipitation zone.
266.25 - 270.25	P-2	Torrifluvents-Haplargids: Very deep and moderately deep, well and moderately well drained, loamy (fine and coarse) and sandy soils developing in alluvium on nearly level to gently sloping floodplains and terraces.	———	20 - 60+	0 - 6	Underlain by clay shale bedrock, moderate water erosion hazard, low to high wind erosion hazard, 10-14 inch precipitation zone.
270.25 - 271.5	407	Samsil-Shale Outcrop: Shallow, poorly drained, clay soils forming in residuum on moderately sloping to steep uplands and sideslopes.	Samsil	10 - 20	5 - 50	Underlain by calcareous clay shale, moderate wind and water erosion hazard, 10-14 inch precipitation zone. Includes areas of shale, slate, and platy clay shale rock outcrops.
271.5 - 273.5	P-4	Torriorthents (shallow): Shallow and very deep, somewhat poorly and poorly drained, loamy and fine textured soils forming in residuum and allluvium (from interbedded shales and sandstones) on moderately sloping to steep upland areas.	———	10 - 60+	5 - 40	Moderate wind and water erosion hazard, 10-14 inch precipitation zone.

Table 1. (concluded)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Natrona County, Wyoming[7,8] (continued)						
273.5 - 278.66	P-2	Torrifluvents-Haplargids: Very deep and moderately deep, well and moderately well drained, loamy (fine and coarse) and sandy soils developing in alluvium on nearly level to gently sloping floodplains and terraces.	______	20 - 60+	0 - 6	Underlain by clay shale bedrock, moderate water erosion hazard, low to high wind erosion hazard, 10-14 inch precipitation zone.

*Soil series that are identified on SCS Form 5 - Soil Interpretation Tables as being difficult to reclaim after soil is removed for construction and/or other uses.

Sources:

[1]U.S. Soil Conservation Service (SCS). Undated. Detailed soil map (excerpt from Rifle Survey) of applicable portion of Garfield County, Colorado (provided by SCS, Glenwood Springs, Colorado).

[2] ______. Undated. General soil association map of Rio Blanco County, Colorado.

[3] ______. Undated. General soil association map of applicable portion of Moffat County, Colorado (provided by SCS, Craig, Colorado).

[4] ______. 1976. General soil map, Colorado. Map no. M7-SE-23503.

[5,7] ______. 1975. General soil map, Wyoming. Map no. M7-SE-23543.

[6] ______. 1978. General soil map, Sweetwater County, Wyoming (provisional).

[8] ______. Undated. Detailed soil map of applicable portion(s) of Natrona County, Wyoming (provided by Bureau of Land Management [BLM], Casper District).

Most of the topsoil in the alluvial areas traversed by the proposed trunkline route is of fair to poor quality (for vegetative growth) due to shallow surface layers, surface textures (e.g., gravelly), or undesirable physical and chemical properties (e.g., permeability, excess salts, alkalinity). These soils are characterized by a generally low to moderate water erosion hazard and a low to high wind erosion hazard. A few of the clayey alluvial soils such as the Absher series (i.e., Deep Creek crossing in southern Moffat County) are highly susceptible to water erosion, and also have a high shrink-swell potential. Additionally, some of the soils along Spring Creek in Moffat County (northeast of Maybell) are unconsolidated (i.e., low strength), and the stream banks of Muddy Creek in Carbon County are highly eroded in some areas. Several of the alluvial soils are occasionally flooded. The alluvial soils are used primarily for livestock and wildlife grazing and to a lesser degree for irrigated hay and pasture.

Upland soils is the other main category of soils which would be traversed by the proposed trunkline. These soils are deep to shallow, primarily well drained, loam, silty clay loam, clay loam, loamy sand, sandy loam, sand, and clay soils. The upland soils include areas of rock outcrop. Several of the upland loam soils identified in Garfield and Rio Blanco counties in Colorado contain channery or are flaggy. The upland soils are developing in residuum and colluvium derived primarily from sedimentary rocks (e.g., sandstone, marlstone, clay shales), and to a lesser extent aeolian sand. These soils are forming on ridges, mountainsides, valley sideslopes, foothills, and upland plains. Upland terrain slopes range from gentle to steep, but the majority of the terrain which would be traversed by the proposed trunkline is moderately to strongly sloping. The proposed trunkline route traverses some moderately steep terrain in Rio Blanco County, Colorado between Piceance Creek and the White River, and northwest of Citadel Plateau in Moffat County, Colorado. Topsoil in the upland

areas is primarily fair to poor because of shallowness, surface textures, and undesirable physical and chemical properties (e.g., shrink-swell potential, excess salts, alkalinity). The upland soils are characterized by a generally moderate water erosion hazard. Several clayey soils that are salt and alkali affected (e.g., Chipeta and Killpack series) in northern Rio Blanco County may tend to disperse when wet (deflocculation), and thus are very prone to water erosion. Wind erosion hazard on the upland soils ranges from slight to high, with sandy soils such as the dune soils southwest of Maybell in Moffat County, Colorado and near Ferris in Carbon County, Wyoming having the highest susceptiblility. A few of the upland soils have a high shrink-swell potential (e.g., Moyerson, Pinelli, and Kemmerer series). Some of these soils are quite difficult to reclaim if the topsoil is removed and not replaced (refer to Table 1). The upland soils are used primarily for livestock and wildlife grazing.

Alternatives.

Southern Rangely Lateral Alternative. The Southern Rangely Lateral Alternative route is within the Central Desertic Basins, Mountains, and Plateaus portion of the Western Range and Irrigated Region (SCS 1978). Annual precipitation generally ranges from 8 to 23 inches along this lateral alternative route, but the majority of this route receives between 14 and 18 inches. Seven different soil associations were identified along this lateral alternative. Table 2 lists (by mileposts) and characteristics the soils which were identified.

As with the proposed trunkline, the soils identified along this lateral alternative route can be generally grouped into two main categories (upland and alluvial soils) according to their physiographic location. The upland soils are shallow and moderately deep, well to

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG THE SOUTHERN RANGELY LATERAL ALTERNATIVE

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1]						
0.0 - 0.2	11	Irigul-Parachute-Rhone: Shallow to deep, well drained, channery loam and loam soils formed in residuum and colluvium derived from sandstone and marlstone on moderately sloping to very steep ridges, sideslopes, and mountainsides.	Irigul* Parachute* Rhone	10 - 20 20 - 40 40 - 60	5 - 75 5 - 65 5 - 30	Underlain by unweathered bedrock (sandstone and marlstone) and channery loams, moderate water erosion hazard, poor to fair topsoil, 18-23 inch precipitation zone.
0.2 - 1.75	8	Piceance-Yamac-Rentsac: Moderately deep, deep, and shallow, well drained, very fine sandy loam, loam, and channery loam soils formed in aeolian, alluvial, and residual materials derived from sedimentary bedrocks on nearly level to moderately steep ridgetops, sideslopes, and alluvial fans.	Piceance* Yamac Rentsac*	20 - 40 60+ 10 - 20	2 - 20 0 - 15 0 - 30	Underlain by sandstone and marlstone, moderate water erosion hazard, low wind erosion hazard, poor to good topsoil, 14-18 inch precipitation zone.
1.75 - 3.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portiou contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
3.25 - 6.75	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout.

Table 2. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
6.75 - 7.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
7.25 - 7.5	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout.
7.5 - 9.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 2. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
9.25 - 10.75	8	Piceance-Yamac-Rentsac: Moderately deep, deep, and shallow, well drained, very fine sandy loam, loam, and channery loam soils formed in aeolian, alluvial, and residual materials derived from sedimentary bedrocks on nearly level to moderately steep ridgetops, sideslopes, and alluvial fans.	Piceance* Yamac Rentsac*	20 - 40 60+ 10 - 20	2 - 20 0 - 15 0 - 30	Underlain by sandstone and marlstone, moderate water erosion hazard, low wind erosion hazard, poor to good topsoil, 14-18 inch precipitation zone.
10.75 - 11.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
11.5 - 12.0	8	Piceance-Yamac-Rentsac: Moderately deep, deep, and shallow, well drained, very fine sandy loam, loam, and channery loam soils formed in aeolian, alluvial, and residual materials derived from sedimentary bedrocks on nearly level to moderately steep ridgetops, sideslopes, and alluvial fans.	Piceance* Yamac Rentsac*	20 - 40 60+ 10 - 20	2 - 20 0 - 15 0 - 30	Underlain by sandstone and marlstone, moderate water erosion hazard, low wind erosion hazard, poor to good topsoil, 14-18 inch precipitation zone.
12.0 - 12.75	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 2. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
12.75 - 13.25	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout.
13.25 - 14.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
14.5 - 15.5	8	Piceance-Yamac-Rentsac: Moderately deep, deep, and shallow, well drained, very fine sandy loam, loam, and channery loam soils formed in aeolian, alluvial, and residual materials derived from sedimentary bedrocks on nearly level to moderately steep ridgetops, sideslopes, and alluvial fans.	Piceance* Yamac Rentsac*	20 - 40 60+ 10 - 20	2 - 20 0 - 15 0 - 30	Underlain by sandstone and marlstone, moderate water erosion hazard, low wind erosion hazard, poor to good topsoil, 14-18 inch precipitation zone.

Table 2. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
15.5 - 16.75	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
16.75 - 17.5	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout.
17.5 - 21.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 2. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
21.5 - 26.25	9	Castner-Veatch-Redcreek: Shallow and moderately deep, well to somewhat excessively drained, channery, channery loams, and sandy loam soils formed in residuum and colluvium (derived from sedimentary rocks) on uplands, mountain sideslopes, and ridgetops; and from aeolian deposits and residuum (derived from sandstone) on uplands and ridgetops.	Castner* Veatch* Redcreek*	10 - 20 20 - 40 10 - 20	5 - 45 10 - 50 5 - 30	Underlain by sandstone or marlstone bedrock, moderate to high water erosion hazard, poor topsoil, 14-18 inch precipitation zone.
26.25 - 28.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
28.25 - 28.75	2	Glendive-Kobar-Havre: Deep, well to somewhat poorly drained, loamy and silty clay loam soils formed in alluvium and colluvium (derived from sedimentary rock) on nearly level to strongly sloping fans, stream terraces, valley bottomlands, and toe slopes.	Glendive Kobar Havre	60+ 60+ 60+	0 - 4 0 - 15 0 - 4	Underlain by stratified loamy and clayey materials, moderate water erosion hazard, fair topsoil, 14-20 inch precipitation zone. These soils are slightly to moderately salt and alkali affected, and the Kobar-Havre portion is generally calcareous throughout.

Table 2. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
28.75 - 33.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
33.25 - 35.0	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottom-lands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.
35.0 - 35.75	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.
35.75 - 36.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep side-slopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 2. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
<u>Rio Blanco County, Colorado</u>[1] (continued)						
36.25 - 37.0	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	<u>High</u> (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.
37.0 - 38.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
38.25 - 39.0	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.
39.0 - 39.25	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	<u>High</u> (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.

Table 2. (concluded)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
<u>Rio Blanco County, Colorado</u>[1] (continued)						
39.25 - 40.25	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.
40.25 - 41.45	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	<u>High</u> (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.

*Soil series that are identified on SCS Form 5 - Soil Interpretation Tables as being difficult to reclaim after soil is removed for construction and/or other uses.

[1]Sources: U.S. Soil Conservation Service (SCS). Undated. General soil association map of Rio Blanco County, Colorado.

somewhat excessively drained, channery-flaggy loams, silty clay, channery loams, sandy loam, and loam soils. Rock outcrops are present on steep sideslopes and ridges. These upland soils are developing primarily in residuum and colluvium (derived from sandstone, marlstone, and clayey shale) and to a lesser extent aeolian and alluvial materials. The upland soils are forming on nearly level to steep uplands, ridges, steep sideslopes, breaks, and ridgetops. Much of the upland terrain is dissected by numerous intermittent drainages. Topsoil is primarily poor due to shallowness, surface textures (e.g. stoney or clayey), and undesirable chemical characteristics (e.g. excess sodium). These soils are characterized by a generally moderate water erosion hazard, but the Redcreek series is highly susceptible to water erosion. Wind erosion hazards range from low to moderate. The Moyerson series has a high shrink-swell potential, and contains excess sodium. All of the upland soils which were identified along this lateral alternative route are difficult to reclaim if the topsoil is removed and not replaced (refer to Table 2). The upland soils are used primarily for livestock and wildlife grazing.

The alluvial soils traversed by the Southern Rangely Lateral Alternative route are deep, well to somewhat poorly drained, loam, silty clay loam, very fine sandy loam, sandy loam, and very gravelly sandy loam soils. These alluvival soils are forming in alluvium, colluvium, and outwash materials (derived from mixed sedimentary and basaltic rocks), and to a lesser extent aeolian sand. The alluvial soils are developing on primarily level to moderatley sloping fans, stream terraces, valley bottomlands , floodplains, benches, and toeslopes. The topsoil in these alluvial areas is of fair to poor quality due to shallowness, surface textures (e.g. stoney), and undesirable physical or chemical characteristics (e.g. clayey, excess salts and alkalinity). These alluvial soils are characterized by a

generally low to moderate wind and water erosion hazard, but the Billings series is highly susceptible to water erosion. Shrink-swell potential ranges from low to moderate. Most of these alluvial soils are salt and alkali affected. These soils are used primarily for livestock and wildlife grazing, although small areas of irrigated cropland (primarily hay) and pasture exist where sufficient water is available.

Northern Rangely Lateral Alternative. This Rangely lateral alternative route is also within the Central Desertic Basins, Mountains, and Plateaus portion of the Western Range and Irrigated Region (SCS 1978). Annual precipitation generally ranges from 8 to 18 inches along this lateral route, but the majority of this route receives between 8 and 14 inches. Five different soil associations were identified along this alternative route. The identified soils are listed (by mileposts) and characterized in Table 3.

As with the proposed trunkline, the soils identified along this Rangely lateral alternative route can be generally grouped into two main categories (upland and alluvial soils) according to their physiographic location. The upland soils are shallow to moderately deep, well drained, channery-flaggy loams, silty clay, silty clay loam, clay loam, fine sandy loam, and loam soils. Rock outcrops are present on ridges and steep sideslopes. The upland soils are developing primarily in residuum and colluvium (derived from sandstone, marlstone, and clayey and gypsiferous shales) and to a lesser extent aeolian and alluvial materials. These soils are forming on nearly level to steep uplands, ridges, sideslopes, low hills, breaks, and toeslopes. Much of the upland terrain is dissected with numerous intermittent drainages. Topsoil is fair to poor due to shallowness, surface textures (e.g., stoney or clayey), and undesirable physical and chemical properties (e.g., shrink-swell poten-

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG THE NORTHERN RANGELY LATERAL ALTERNATIVE

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1]						
0.0 - 4.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shlee) on uplands ridges, and sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
4.25 - 6.25	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.
6.25 - 8.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a <u>high</u> shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
8.25 - 10.5	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	<u>High</u> (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.

Table 3. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
10.5 - 13.75	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
13.75 - 14.25	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.
14.25 - 15.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
15.5 - 16.75	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.

Table 3. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
16.75 - 17.25	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottom-lands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.
17.25 - 18.25	3	Turley-Cliffdown-Kinnear: Deep, well drained, fina sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precip-pitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.
18.25 - 19.75	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey ahlae) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderata water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
19.75 - 20.5	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precip-pitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.

Table 3. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
20.5 - 21.0	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.
21.0 - 21.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
21.5 - 22.0	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.
22.0 - 23.75	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.

Table 3. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
23.75 - 24.5	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping flood plains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.
24.5 - 27.0	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.
27.0 - 27.5	5	Walknolls-Potts-Gaynor: Shallow, deep, and moderately deep, well drained, channery and fine sandy loams, loam, and silty clay loam soils formed in residuum (from sandstone and calcareous shale) and alluvium and aeolian materials derived primarily from sedimentary rock on nearly level to steep upland hills, ridges, and sideslopes.	Walknolls* Potts Gaynor*	10 - 20 60+ 20 - 40	5 - 50 0 - 20 0 - 30	Moderate water erosion hazard, low to moderate wind erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Gaynor portion has high shrink-swell potential, Potts-Gaynor portion is slightly salt and alkali affected.
27.5 - 28.0	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 3. (concluded)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
28.0 - 28.5	5	Walknolls-Potts-Gaynor: Shallow, deep, and moderately deep, well drained, channery and fine sandy loams, loam, and silty clay loam soils formed in residuum (from sandstone and calcareous shale) and alluvium and eeolian materials derived primarily from sedimentary rock on nearly level to steep upland hills, ridges, and sideslopes.	Walknolls* Potts Gaynor*	10 - 20 60+ 20 - 40	5 - 50 0 - 20 0 - 30	Moderate water erosion hazard, low to moderate wind erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Gaynor portion has high shrink-swell potential, Potts-Gaynor portion is slightly salt and alkali affected.
28.5 - 35.0	4	Chipeta-Killpack: Shallow and moderately deep, well drained, silty cley loam and clay loam soils formed in residuum and colluvium derived primarily from gypsiferous shale on nearly level to moderately steep low hills, ridges, and toeslopes.	Chipeta* Killpack	10 - 20 20 - 40	1 - 30 1 - 12	Underlain by weathered shale bedrock, high water erosion hazard, poor to fair topsoil (excess salts), 8-10 inch precipitation zone. Moderately to strongly salt and alkali affected, moderate shrink-swell potential.
35.0 - 35.4	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty cley loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping floodplains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential; all these soils are salt and alkali affected.

*Soil series that are identified on SCS Form 5 - Soil Interpretation Tables as being difficult to reclaim after soil is removed for construction and/or other uses.

[1]Source: U.S. Soil Conservation Service (SCS). Undated. General soil association map of Rio Blanco County, Colorado.

tial, alkalinity, excess salts). These soils are characterized by a generally moderate water erosion hazard, but the Chipeta and Killpack series are highly susceptible. Wind erosion hazard is low to moderate. The Gaynor and Moyerson series have a high shrink-swell potential throughout the profile. The majority of these upland soils are slightly to strongly salt and alkali affected. Most of these soils are difficult to reclaim if the topsoil is removed and not replaced (refer to Table 3). These soils are used primarily for livestock and wildlife grazing.

The alluvial soils traversed by this Rangely lateral alternative route are deep, well and moderately well drained, fine sandy loams, silty clay loam, gravelly sandy loam, very fine sandy loam, loamy sand, sandy loam, and loam soils. These soils are developing in alluvium and outwash (derived from mixed sedimentary and basaltic rocks) and to a lesser degree aeolian sand on primarily level to moderately sloping fans, floodplains, terraces, benches, and narrow valley bottomlands. The Cliffdown series occurs on breaks of benches and terraces, including short steep slopes. Topsoil in the alluvial areas traversed by this lateral alternative is of fair to poor quality, due to shallowness, surface textures (e.g., stoney), and undesirable physical and chemical properties (e.g., too clayey, excess salts, alkalinity). The alluvial soils identified along this lateral alternative route are moderately susceptible to water and wind induced soil erosion, except for the Billings series which is highly susceptible to water erosion. Shrink-swell potential ranges from low to moderate. Most of the alluvial soils are slightly to strongly salt and alkali affected. These alluvial soils are used primarily for livestock and wildlife grazing, and to a lesser extent for irrigated cropland (primarily hay) and pasture where sufficient water is available.

<u>White River Alternative</u>. The affected soils environment for the White River Alternative is essentially the same as the corresponding portion of the proposed trunkline, although this alternative includes some clayey soils (e.g. Billings, Chipeta, and Killpack series) which are highly susceptible to water-induced soil erosion. The soils identified along this alternative are listed (by mileposts) and characterized in Table 4.

<u>Yampa River Alternative</u>. The affected soils environment for the Yampa River Alternative is essentially the same as the corresponding portion of the proposed trunkline. Overall, the terrain traversed by this alternative is about the same (except for steep area near Citadel Plateau in Moffat County) as the terrain traversed by the corresponding portion of the proposed trunkline. The portion of this alternative route which is in the sand dune area southwest and west of Maybell, Colorado is not parallel to the prevailing wind direction, and this alternative avoids the unconsolidated soils along Spring Creek (northeast of Maybell). Table 5 lists (by mileposts) and characterizes the soils identified along this alternative.

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG THE WHITE RIVER ALTERNATIVE

Milepost	Map Symbol	Soil Association or Croup Name and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1]						
0.0 - 1.25	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink - swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
1.25 - 2.5	8	Piceance-Yamac-Rentsac: Moderately deep, deep, and shallow, well drained, very fine sandy loam, loam, and channery loam soils formed in aeolian, alluvial, and residual materials derived from sedimentary bedrocks on nearly level to moderately steep ridgetops, sideslopes, and alluvial fans.	Piceance* Yamac Rentsac*	20 - 40 60+ 10 - 20	2 - 20 0 - 15 0 - 30	Underlain by sandstone and marlstone, moderate water erosion hazard, low wind erosion hazard, poor to good topsoil 14-18 inch precipitation zone.
2.5 - 5.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandston, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.
5.5 - 7.5	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.

Table 4. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
7.5 - 9.0	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and (clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop of up to 90% slope on outcrop ridge caps, bluffs, and canyon walls.
9.0 - 9.5	3	Turley-Cliffdown-Kinnear: Deep, well drained, fine sandy loam, very gravelly sandy loams, loamy sands, and loam soils forming in alluvium and outwash (from mixed sedimentary and basaltic rocks) and aeolian sand on level to steep fans, terraces, benches, and breaks (dissected).	Turley Cliffdown Kinnear	60+ 60+ 60+	0 - 8 0 - 65 0 - 10	Moderate wind and water erosion hazard, fair to poor topsoil, 8-12 inch precipitation zone. Turley-Cliffdown portion is often or occasionally slightly salt and alkali affected.
9.5 - 11.0	1	Billings-Uffens-Colorow: Deep, well and moderately well drained, silty clay loam, very fine sandy loam, and sandy loam soils formed in alluvium (derived from sedimentary rock and basalt) on nearly level to moderately sloping flood plains, stream terraces, and narrow valley bottomlands.	Billings Uffens Colorow	60+ 60+ 60+	0 - 6 0 - 8 0 - 4	High (Billings) and moderate water erosion hazard, moderate wind erosion hazard, fair to poor topsoil (clay, salts, thin, stones), 8-14 inch precipitation zone. Billings portion has a moderate shrink-swell potential, all these soils are salt and alkali affected.
11.0 - 14.5	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

Table 4. (concluded)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
Rio Blanco County, Colorado[1] (continued)						
14.5 - 15.0	4	Chipeta-Killpack: Shallow and moderately deep, well drained, silty clay loam and clay loam soils formed in residuum and colluvium derived primarily from gypsiferous shale on nearly level to moderately steep low hills, ridges, and toeslopes.	Chipeta* Killpack	10 - 20 20 - 40	1 - 30 1 - 12	Underlain by weathered shale bedrock, high water erosion hazard, poor to fair topsoil (excess salts), 8-10 inch precipitation zone. Moderately to strongly salt and alkali affected, moderate shrink-swell potential.
15.0 - 16.0	6	Rentsac-Moyerson-Rock Outcrop: Shallow, well drained, channery-flaggy loams and silty clay soils formed in residuum (derived from sandstone, marlstone, and clayey shale) on uplands, ridges, and steep sideslopes.	Rentsac* Moyerson*	10 - 20 10 - 20	2 - 45 10 - 60	Underlain by sandstone, marlstone, and shale bedrock, moderate water erosion hazard, low to moderate wind erosion hazard, poor topsoil, 14-18 inch precipitation zone. The Moyerson portion contains excess sodium and has a high shrink-swell potential. Includes rock outcrop areas of up to 90% slope on ridge caps, bluffs, and canyon walls.

*Soil series that are identified on SCS Form 5 - Soil Interpretation Tables as being difficult to reclaim after soil is removed for construction and/or other uses.

[1]Source: U.S. Soil Conservation Service (SCS). Undated. General soil association map of Rio Blanco County, Colorado.

Table 5. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG THE YAMPA RIVER ALTERNATIVE

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Moffat County, Colorado[1]						
0.0 - 5.0	1	Pinelli-Kemmerer-Forelle: Deep and moderately deep, well drained, loam and silty clay loam soils forming in calcareous aeolian and mixed materials weathered from shale and sandstone on gently sloping to moderately steep upland ridges, drainageways and hills.	Pinelli Kemmerer Forelle	60+ 20 - 40 60+	2 - 30 2 - 30 2 - 30	Subsoils are clay loams and silty clay loams, moderate water erosion hazard, topsoil is primarily fair to poor, 10-14 inch precipitation zone. Pinelli-Kemmerer portion has <u>high</u> shrink-swell potential to a depth of 2 feet.
5.0 - 5.5	5	Rentsac-Crestman-Rock Outcrop: Shallow, well and excessively drained, channery loam and loamy sand soils formed in materials weathered from sandstone on moderately sloping to steep upland ridges, mountains, sideslopes, and breaks.	Rentsac* Crestman*	10 - 20 10 - 20	5 - 45 5 - 50	Underlain by sandstone, moderate water erosion hazard, Crestman portion has <u>high</u> wind erosion hazard, topsoil is poor, 7-14 inch precipitation zone. Includes areas of sandstone rock outcrops.
5.5 - 7.0	3	Rhone-Burnette-Skyway: Deep to moderately deep, well drained, fine sandy loam and loam soils formed in colluvium and residuum (derived from sandstone and shale) on moderately sloping to very steep mountainsides and benches.	Rhone Burnette Skyway	60+ 60+ 20 - 40	5 - 75 3 - 65 5 - 40	Underlain by sandy and heavy clay loams, moderate water erosion hazard, topsoil is good to poor (good up to 8% slopes), 17 inch precipitation zone.
7.0 - 8.0	2	Regent-Work: Moderately deep to deep, well drained, silty clay loam and clay loam soils forming in alluvium and residuum from shale on gently sloping to moderately steep upland benches and mountainsides.	Regent Work	20 - 60 60+	2 - 9 2 - 30	Underlain by silty clay loam and gravelly clay loam subsoils, moderate water erosion hazard, fair to poor topsoil, 14-17 inch precipitation zone, <u>high</u> to moderate shrink-swell potential. Includes areas of rock outcrop on the steeper mountain slopes and ridge sideslopes.
8.0 - 13.0	7	Evanston-Rock River-Grieves: Deep, well drained, loam, sandy loam, and loamy sand soils forming in alluvium on nearly level to very steep hillsides, ridges, and fans.	Evanston Rock River Grieves	60+ 60+ 60+	0 - 25 0 - 65 10 - 40	Underlain by clay loam, sandy clay loam, and sandy loam subsoils, moderate to low water erosion hazard, Grieves portion is <u>highly</u> susceptible to wind erosion, topsoil is primarily fair to poor, 10-15 inch precipitation zone.

Table 5. (continued)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
<u>Moffat County, Colorado</u>[1] (continued)						
13.0 - 22.5	14	Zeona-Ryan Park-Rock River: Deep, excessively to well drained, loamy sand, loamy fine sand, and sandy loam soils formed in aeolian deposits and alluvium on primarily gently sloping to strongly sloping hills, mesas, alluvial fans, and toe slopes.	Zeona Ryan Park Rock River	60+ 60+ 60+	5 - 30 2 - 12 0 - 65	Underlain by sandstone bedrock, low to moderate water erosion hazard, Zeona-Ryan Park portion is <u>highly</u> susceptible to wind erosion, primarily poor to fair topsoil, 10-14 inch precipitation zone.
22.5 - 23.0	7	Evanston-Rock River-Grieves: Deep, well drained, loam, sandy loam, and loamy sand soils forming in alluvium on nearly level to very steep hillsides, ridges, and fans.	Evanston Rock River Grieves	60+ 60+ 60+	0 - 25 0 - 65 10 - 40	Underlain by clay loam, sandy clay loam, and sandy loam subsoils, moderate to low water erosion hazard, Grieves portion is <u>highly</u> susceptible to wind erosion, topsoil is primarily fair to poor, 10-15 inch precipitation zone.
23.0 - 25.0	14	Zeona-Ryan Park-Rock River: Deep, excessively to well drained, loamy sand, loamy fine sand, and sandy loam soils formed in aeolian deposits and alluvium on primarily gently sloping to strongly sloping hills, mesas, alluvial fans, and toe slopes.	Zeona Ryan Park Rock River	60+ 60+ 60+	5 - 30 2 - 12 0 - 65	Underlain by sandstone bedrock, low to moderate water erosion hazard, Zeona-Ryan Park portion is <u>highly</u> susceptible to wind erosion, primarily poor to fair topsoil, 10-14 inch precipitation zone.
25.0 - 27.0	5	Rentsac-Crestman-Rock Outcrop: Shallow, well and excessively drained, channery loam and loamy sand soils formed in materials weathered from sandstone on moderately sloping to steep upland ridges, mountains, sideslopes, and breaks.	Rentsac* Crestman*	10 - 20 10 - 20	5 - 45 5 - 50	Underlain by sandstone, moderate water erosion hazard, Crestman portion has <u>high</u> wind erosion hazard, topsoil is poor, 7-14 inch precipitation zone. Includes areas of sandstone rock outcrops.

Table 5. (concluded)

Milepost	Map Symbol	Soil Association or Group Name and Description	Soil Series	Depth to Bedrock (Inches)	Slope (%)	Comments
27.0 - 38.4	10	Relsob-Zeona-Rock River: Deep, well and somewhat excessively drained, loamy sand, and sandy loam soils formed in mixed alluvium and residuum (weathered primarily from sandstone) on gently to strongly sloping ridges, hillsides, and benches.	Relsob Zeona Rock River	60+ 60+ 60+	3 - 15 5 - 30 0 - 65	Underlain by sandy clay loam, and loamy sand subsoils, low to moderate water erosion hazard, Zeona portion is <u>highly</u> susceptible to wind erosion, primarily fair to poor topsoil, 10-14 inch precipitation zone.

*Soil series that are identified on SCS Form 5 - Soil Interpretation Tables as being difficult to reclaim after soil is removed for construction and/or other uses.

[1]Source: U.S. Soil Conservation Service (SCS). Undated. General soil association map of applicable portion of Moffat County, Colorado.

ENVIRONMENTAL CONSEQUENCES

Soils

Proposed Trunkline. Construction of the proposed trunkline (including pump stations) would disturb approximately 3400 acres of soils and topography. Construction of staging/work areas at major river and road crossings would cause a small amount of additional disturbance. Soil surface disturbance, excavation (trenching and cut-and-fill operations), and removal of vegetative cover would cause increases in existing soil erosion rates and soil instability. These increases would continue until denuded areas were revegetated. Assuming a moderately intensive erosion control and reclamation program (refer to Chapter 2 of the DEIS) was implemented following construction, the majority of the disturbed right-of-way should recover within one or two years, but some areas might require up to five years. The soils data in the Affected Environment section (including Table 1) of this background report indicates that some areas would be difficult to reclaim due to adverse physical and chemical soil properties such as: undesirable surface textures; poor topsoil; high erosion susceptibility; excess salts; and alkalinity. In addition, areas of steeply sloping terrain and low available moisture could inhibit the success of reclamation efforts. In some areas it might be necessary to reseed several times, and special erosion control practices might have to be employed to stabilize soils prior to successful revegetation. Water bars and possibly other water diversion techniques would be used on sloping areas to reduce water erosion and help maintain soil stability. Selection of seed species specifically adapted to local soils (and climates), as well as timing and methods of reseeding, are essential prerequisites for successful revegetation on problem soil areas (e.g. excess salts, alkalinity, droughtiness). Excess salts and alkalinity problems could increase in some areas if trenched materials,

which in some cases are more toxic than the overlying topsoils, were placed on the surface. Revegetation success and erosion control could be increased in areas of salt affected clay soils (e.g. Chipeta and Killpack series), which may tend to disperse when wet, by bringing in four or more inches of new topsoil.

The sand dune areas southwest of Maybell, Colorado (MP 61-71) and near Ferris in Carbon County, Wyoming (MP 200-215) are of special concern due to the high wind erosion hazards. Parts of these dune areas are not stabilized or vegetated. Conversations with local Soil Conservation Service (SCS) personnel indicate that the prevailing wind direction in the dune area southwest of Maybell is parallel to the proposed right-of-way, thus increasing the wind erosion hazard (Robinson 1981). Intensive mitigation measures may be required to stabilize the right-of-way in these areas and successful revegetation may be difficult to accomplish. Special mitigation measures in dune areas could include one or more of the following: anchored fences (perpendicular to the right-of-way); nylon netting; asphalt or hydro-mulches; crop residue mulches; addition of coarse particles such as cobbles; and reseeding with an adapted grass species (e.g. sand dropseed). Special construction measures in dune areas should include burying the pipeline deeply and minimizing vegetation disturbance.

A monitoring program would be conducted over the life of the pipeline and would include identification of problem soil erosion areas and other areas not responding adequately to the revegetation program. Once identified, problem soil areas would undergo more intensive reclamation/mitigation in order to help ensure soil stability, structural integrity of the pipeline, renewed forage production, and an aesthetically acceptable condition.

Specific Mitigation Measures Generated by the Impact Assessment. No specific mitigation measures were generated by the impact assessment, but the Soils Background Report discusses problem soil areas and potential mitigation measures.

Unavoidable Adverse Impacts. Unavoidable adverse impacts to the soils resource from construction of the proposed action and/or alternatives would include: 1) increases in soil erosion and soil instability on disturbed areas; and 2) decreased soil productivity in the short-term. Increases in soil erosion and instability would generally be short-term impacts, assuming a moderately intensive erosion control and reclamation program was implemented following construction.

Relationships Between the Short-Term Use of the Affected Environment and the Enhancement of Long-Term Productivity. Assuming the erosion control and reclamation measures implemented following construction are moderately successful, impacts to the soils resource should not result in significant long-term productivity losses.

Irreversible and Irretrievable Commitments of Resources. Short-term increases in soil erosion due to construction of the proposed action would not cause disturbed areas to be irreversibly converted to other uses, and the viability of these areas should not be significantly diminished.

Alternatives.

Southern Rangely Lateral Alternative. Construction of the Southern Rangely Lateral Alternative would disturb approximately 497 acres of soils and topography. As with the proposed trunkline route, soil surface disturbance, excavation, and removal of vegetative cover

would cause increases in existing soil erosion rates and soil instability until denuded ares were revegetated. If a moderately intensive erosion control and reclamation program (refer to Chapter 2 of the DEIS) was implemented following construction, most of the right-of-way should recover within one or two years. The soils data presented in the Affected Environment section (including Table 2) of this background report indicates that the same reclamation problems discussed for the proposed trunkline route would be encountered on this Rangely lateral route, although sand dune areas would not present a potential problem. Approximately 71 percent of the soils identified along this alternative are difficult to reclaim if the topsoil is removed and not replaced (refer to Table 2). Therefore, topsoiling along this route would greatly increase reclamation success. The monitoring program discussed for the proposed trunkline would also include the Rangely lateral which is selected.

<u>Northern Rangely Lateral Alternative</u>. Construction of the Northern Rangely Lateral Alternative would disturb approximately 424 acres of soils and topography. Soil surface disturbance, excavation, and removal of vegetative cover would cause increases in existing soil erosion rates and soil instability until denuded areas were revegetated. Assuming a moderately intensive erosion control and reclamation program was implemented following construction, most of the right-of-way should recover within one or two years. The soils data presented in the Affected Environment section (including Table 3) of this backbround report indicates that the same reclamation problems discussed for the proposed trunkline route would be encountered on this Rangely lateral route, but sand dune areas would not present a potential problem. Approximately 57 percent of the soils identified along this alternative route are difficult to reclaim if the topsoil is removed and not replaced (refer to Table 3). Therefore, topsoiling along this route would increase reclamation success. Additionally, revegetation success and erosion control could be increased on erodible salt

affected clayey soils (i.e. Chipeta and Killpack series; MP 28.5-35.0) by bringing in 4 or more inches of new topsoil.

White River Alternative. Construction of the White River Alternative would disturb approximately 194 acres of soils and topography, versus approximately 133 acres of disturbance for the corresponding portion of the proposed trunkline. Potential impacts to the soils resource from construction of the White River Alternative would be about the same as those listed for the proposed trunkline. This alternative includes some clayey soils (MP 9.5-11.0; and 14.50-15.0) which are highly susceptible to water-induced soil erosion. These clay soils would be harder to reclaim than the soils on the corresponding portion(s) of the proposed trunkline.

Yampa River Alternative. Construction of the Yampa River Alternative (including pump station) would disturb approximately 464 acres of soils and topography, versus approximately 451 acres of disturbance for the corresponding portion of the proposed trunkline (including pump station). Potential impacts to the soils resource from construction of the Yampa River Alternative would be about the same as those listed for the proposed trunkline. The terrain traversed by the Yampa River Alternative is about the same (overall) as the corresponding portion of the proposed trunkline, but this alternative traverses steep terrain (approximately 38 percent slope) near Citadel Plateau (MP 5.5-5.6) in Moffat County, Colorado. Following construction, this area would require intensive mitigation to stabilize and reclaim. Since the portion of this alternative route in the sand dune area southwest and west of Maybell, Colorado (MP 13-20) is not parallel to the prevailing wind direction, this area would probably be easier to stabilize and revegetate than the corresponding sand dune portion of the proposed trunkline (MP 61-71). This alternative also avoids the unconsolidated soils (traversed by the proposed trunkline) along Spring Creek.

AFFECTED ENVIRONMENT

Prime Agricultural Lands

Proposed Trunkline. Since the four pump stations associated with the proposed trunkline route could potentially take agricultural land out of production for the life of the project (50 years), each proposed pump station location was evaluated to determine whether it included prime agricultural land. Applicable Soil Conservation Service (SCS) and BLM offices were contacted for prime agricultural land information at the proposed pump station locations. The proposed Parachute, Baggs, and Rawlins pump stations would not be located on prime agricultural land (Tardy 1981; Larson 1981; and Beroz 1981). The area east of Deception Creek within the proposed Maybell pump station location (T7N, R95W, section 32, SE 1/4) is potential prime agricultural land (SCS undated a,b). For this area to qualify as prime agricultural land it must be smooth terrain of less than 6 percent slope and it must be irrigated. Analysis of topographic maps and aerial photography indicate that the area east of Deception Creek does not exceed 6 percent slope and that the area is irrigated; thus, the area east of Deception Creek qualifies as prime agricultural land.

Alternatives.

Rangely Lateral Alternatives. The Rangely lateral alternatives would not include any additional pump stations.

White River Alternative. The White River Alternative does not involve any new pump stations.

Yampa River Alternative. Approximately 75 percent of the pump station location (T7N, R96W, section 23, NW 1/4) associated with the Yampa River Alternative is potential prime agricultural land (Alstatt 1981). For this area to qualify as prime it must be irrigated. Only

about 10 acres (adjacent to Yampa River) of this potential prime agricultural land is irrigated; thus, approximately 94 percent of the Yampa River Alternative pump station location does not qualify as prime.

ENVIRONMENTAL CONSEQUENCES

Prime Agricultural Lands

Proposed Trunkline. Three (Parachute, Baggs, and Rawlins) of the four pump stations associated with the proposed trunkline would not be located on prime agricultural land. As long as the proposed Maybell pump station is not located east of Deception Creek (E1/2, NE1/4, SE1/4; and SE1/4, SE1/4, section 33, T7N, R95W), the proposed action would not cause any long-term crop production losses on prime agricultural land.

Alternatives.

Yampa River Alternative. As long as the pump station associated with the Yampa River Alternative is not located adjacent to the Yampa River (e.g. between State Highway 318 and the river), no long-term crop production losses on prime agricultural land would occur.

LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

SURFACE WATER
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

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LA SAL PIPELINE PROPOSAL
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INTRODUCTION

This report documents the impact analysis of potential surface-water effects associated with the La Sal shale oil pipeline project. The Affected Environment section identifies the environmental (surfacewater) resources that could be affected.

The Environmental Consequences section presents impact analyses for three potential effects: stream crossings, hydrostatic test water discharge, and flooding.

AFFECTED ENVIRONMENT

Trunkline

The proposed trunkline would cross numerous washes, creeks, streams and rivers. Based upon the U.S. Geological Survey topographic maps, these crossings can be classified as either intermittent or perennial waterways. The perennial streams and rivers can be further classified as either major or minor.

Certain major river crossings have been identified (Exxon Pipeline Company, letter March 6, 1981) that would require site-specific construction design plans. These crossings, along with any crossings

that could require an individual Corps of Engineers dredge and fill permit, are classified as major perennial rivers. All other perennial crossings are classified as minor perennial streams and rivers.

Table 1 shows the major and minor perennial streams and rivers that would be crossed by the proposed trunkline. Construction of the proposed stream crossings would take place during periods of low flow. Therefore, intermittent creeks and washes, which would be dry during construction activities, are not evaluated as part of this surface water analysis.

Alternatives

The major and minor perennial streams and rivers that would be crossed by the four alternative routes (Southern Rangely Lateral Alternative, Northern Rangely Lateral Alternative, White River Alternative, and Yampa River Alternative) are listed in Table 2.

ENVIRONMENTAL CONSEQUENCES

Stream Crossings

Potential Construction Methods. The particular type of trench and fill operation at stream crossings would depend upon the stream width and depth and underlying streambed materials. In minor perennial streams, half the flow could be temporarily diverted and the pipeline trenched "dry" with the aid of dewatering wells, or spread equipment (backhoes) could be used directly in the stream. Major perennial rivers would likely be trenched by draglines from shore or with draglines or backhoes on moveable mats or barges. Based upon a reivew of stream crossing construction practices for these types of crossings (Northam 1980; Pendarius 1980; Williams 1980) the dredge and fill rate for perennial stream and river crossings is estimated to be 100 to 150 cubic yards per hour, with a shovel capacity of 1-1/2 cubic yards.

Table 1. LOCATION AND CLASSIFICATION OF STREAM CROSSINGS FOR PROPOSED TRUNKLINE

Stream Crossings	State	Approximate Milepost	Stream Classification[a]	Beneficial Uses
<u>Major Perennial</u>				
White River	Colorado	37	Unclassified	AQU (Warm water); REC2; SUP; AGR
Yampa River	Colorado	70	Unclassified	AQU (Warm water); REC2; SUP; AGR
Little Snake River	Colorado	109	Unclassified	AQU (Cold water): REC1; SUP; AGR
<u>Minor Perennial</u>				
Stewart Gulch	Colorado	15	Unclassified	Not Determined
Piceance Creek	Colorado	16,30,33	Unclassified	Not Determined
Muddy Creek	Wyoming	135	III	FISH (Cold water non-game); REC2; IRR; SWL
Separation Creek	Wyoming	180	IV	SWL
Sweetwater River	Wyoming	234	II	FISH (Cold water game); REC2; IRR; SWL
Horse Creek	Wyoming	239	II	FISH (Cold water game); REC2; IRR; SWL
Fish Creek	Wyoming	243	II	FISH (Cold water game); REC2; IRR; SWL
Casper Canal	Wyoming	265	IV	IRR
Poison Spider Creek	Wyoming	269	IV	SWL

LEGEND

<u>Beneficial Uses</u>

- FISH Fishery
- AQU Aquatic Life
- REC1 Primary Contact Recreation
- REC2 Secondary Contact Recreation
- SUP Domestic Water Supply
- AGR Agriculture
- IRR Irrigation
- SWL Stock and Wildlife Watering

<u>Stream Classification</u>

The State of Colorado classifies streams only by the designated beneficial uses, and does not have numerical classifications.

The State of Wyoming classifies streams as Class I (highest quality, no further degradation allowed); Class II (game fish); Class III (non-game fish); and Class IV (poorest quality and not suitable for any fish life.)

[a]Source: Wagner 1981; Anderson 1981; Squire 1981.

Table 2. LOCATION AND CLASSIFICATION OF STREAM CROSSINGS FOR ALTERNATIVE ROUTES

Stream Crossings	State	Approximate Milepost	Stream Classification[a]	Beneficial Uses
Southern Rangely Lateral Alternative (AB)				
Major Perennial				
White River	Colorado	41	Unclassified	AQU (Warm water); REC2; SUP; AGR
Minor Perennial				
Yellow Creek	Colorado	13	Unclassified	Not Determined
Duck Creek	Colorado	17	Unclassified	Not Determined
Spring Creek	Colorado	28	Unclassified	Not Determined
Northern Rangely Lateral Alternative (DEB)				
Major Perennial				
White River	Colorado	26	Unclassified	AQU (Warm water); REC2; SUP; AGR
Minor Perennial				
Yellow Creek	Colorado	8	Unclassified	Not Determined
Fletcher Gulch	Colorado	22	Unclassified	Not Determined
Spring Creek	Coloardo	24	Unclassified	Not Determined
White River Alternative (CEF)				
Major Perennial				
White River	Colorado	10	Unclassified	AQU (Warm water); REC2; SUP; AGR
Yampa River Alternative (GHI)				
Major Perennial				
Yampa River	Colorado	23	Unclassified	AQU (Warm water); REC2; SUP; AGR

LEGEND

Beneficial Uses
- AQU Aquatic Life
- REC2 Secondary Contact Recreation
- SUP Domestic Water Supply
- AGR Agriculture

Stream Classification
The State of Colorado classifies streams only by the designated beneficial uses, and does not have numerical classifications.

[a]Source: Wagner 1981; Anderson 1981; Squire 1981.

Background Data. Few published data are available that describe the effects upon receiving water quality associated with stream crossing construction activity (e.g., increases in levels of suspended solids and turbidity). Crabtree et al. (1978) presented the results of pipeline construction monitoring for three small creek crossings in Michigan. The levels of fine suspended sediment (less than 0.063 mm) reached 280 to 4200 mg/1, while coarse solids (greater than 0.063 mm) reached 70 to 450 mg/1, at distances of 30 to 100 feet downstream of trenching operations. Hay (1972) found that suspended sediment levels downstream of stream crossing construction activities in a shallow (18 inches in depth) Michigan trout stream (sand and gravel bed) did not increase by more than 10 mg/1, at distances of 300 feet downstream. Landeen and Brandt (1975) investigated the increases in suspended sediment levels associated with instream pipeline construction (draglines) on two rapidly flowing Alaskan rivers. In the La Biche River, trenching operations were found to generate suspended sediment levels of 100 to 200 mg/1, persisting downstream a distance of 1,300 feet. In the Rotaneelee River, the concentration of suspended sediment reached 52 mg/1 at 100 feet downstream of trenching. Samples taken 24 hours after trenching had ceased indicated that less than 10 mg/1 of sediments remained in suspension as a result of construction activities.

Specific field monitoring data is unavailable for similar pipeline stream crossings along the proposed trunkline and alternative routes, based upon a review of data available from the U.S. Soil Conservation Service, U.S. Geological Survey, U.S. Army Corps of Engineers, and other agencies.

Method of Analysis. A precise estimation of instream construction effects at any particular crossing would require detailed information related to stream bed material characteristics, stream velocity and

depth, mass transfer rate, and other factors. Such data are not available for most of the crossings. Therefore expected crossing effects were estimated for generic crossing types, each having assumed typical stream characteristics. For the purpose of this evaluation, two crossing types have been evaluated: minor perennial streams and major perennial rivers.

Minor Crossings. To estimate the effect of dredge and fill activities at minor perennial streams, the following first order rate equation is applied to account for the settling of particles, (and hence reduction in level of suspended solids), downstream (longitudinally) of trenching operations. It is assumed that complete mixing would take place due to the width and depth at most minor crossings.

$$Cx = Co\ e^{-kt}$$

$$= Co\ e^{-\left[\left(\frac{vs}{d}\right)\left(\frac{x}{u}\right)\right]}$$

where:

Cx = Concentration of suspended solids at some distance x downstream

Co = Initial concentration of suspended solids, in the water column, at the trenching site

Vs = Settling velocity

d = Depth

x = Distance downstream

u = Current velocity

k = Reaction rate

t = Time

Average depth and current velocity have been estimated from U.S. Geological Survey records (1981) for crossings at or near existing gaging stations, during months when construction could take place. Typical conditions at a minor crossing are estimated for a current velocity of 0.5 ft per sec (15.2 cm/sec) and a depth of 0.5 ft (15.2 cm). Bed material size characteristics have been estimated from U.S. Geological Survey Water Resources Data (1957-80) and foundation boring logs at bridge crossings.

U.S. Geological records of bed material samples taken from Wyoming streams and rivers indicate fairly large mean particle diameters, ranging from 0.95 to 9.9 mm. This size corresponds to very coarse sand ranging up to medium gravel, according to the classification adopted by the Sediment Terminology of the American Geophysical Union (Lane 1947). Bridge boring logs taken at rivers crossed in Colorado indicate that the bed materials are predominantly sand, gravely sand, gravel and cobbles. Infrequently, lenses of silty sand may also be present. Therefore, the most probable type of bed material is likely to be sand and gravel. To examine a worst case particle size (e.g., finest particles) a silty sand will be considered. This represents the lower end of the range of particle sizes likely to be encountered.

According to the AASHTO Manual on Foundation Engineering (1967) silty sands may be composed of 20 percent clay, 40 percent silt and 40 percent sand. Based on the standards adopted by the Subcommittee on

Sediment Terminology of the American Geophysical Union (Lane 1947) this classification would represent a mean particle diameter of approximately 0.082 mm, which is used for the analysis of typical trenching activities. The specific weight is given (Trask 1931) as 86 lbs per ft^3 (1378 kg/m^3).

The settling velocity for this size particle is estimated (Schubel 1978) to be 0.3 cm/sec. To estimate a mass discharge rate, a worst case trench and fill rate of 150 cu yd/hr and 1.5 cubic yard shovel capacity is used. This is transformed into a mass discharge rate by:

$$150 \, \frac{\text{cu yd}}{\text{hr}} \times \frac{1 \text{ cycle}}{1.5 \text{ cu yd}} = 100 \, \frac{\text{cycles}}{\text{hr}} = \frac{36 \text{ sec}}{\text{cycle}}$$

$$\times \; 50\% \text{ of cycle within water column}$$

$$= 18 \text{ sec/cycle}$$

$$1.5 \, \frac{\text{cu yd}}{\text{cycle}} \times \frac{1 \text{ cycle}}{18 \text{ sec}} = 0.08 \, \frac{\text{cu yd}}{\text{sec}}$$

$$M = 0.08 \, \frac{\text{cu yd}}{\text{sec}} \times \frac{0.765\text{m3}}{\text{cu yd}} \times 1378 \, \frac{\text{kg}}{\text{m}^3}$$

$$= 8.4 \times 10^7 \text{ mg/sec}$$

Recent investigations by the U.S. Army Corps of Engineers, (Schubel et al. 1978) indicate that an average of one percent of the mass discharge will become suspended in the water column at or adjacent to a typical river dredge and fill site. Therefore the initial concentration Co, is given as 8.4×10^5 mg/sec.

<u>Major Crossings</u>. At a major crossing, due to the depth and width of the stream, the plume would not be completely mixed across the streambed. The plume would disperse, not only longitudinally, but horizontally across the stream. Based upon work completed by Okubo

(1971) the rate of horizontal spread in rivers is given as 0.5 cm/sec. The dispersion of the plume is then given as:

$$Cx = \frac{Co}{u\left(.5\,\frac{x}{u}\right)d}\, e^{-kt}$$

$$= \frac{Co}{(.5)(x)(d)}\, e^{\left[\left(\frac{vs}{D/2}\right)\left(\frac{x}{u}\right)\right]}$$

The same worst case settling velocity (to mid-depth of the river) and mass discharge rate are used for this type of crossing. A depth of three feet (91 cm) and current velocity of 1.2 ft/sec (36.6 cm/sec) is assumed, based upon available gaging records.

<u>Results</u>. Table 3 indicates the estimated increase in level of suspended solids, above background, for a minor and major perennial. stream crossing.

It should be noted that these estimates have assumed a typical bed material size based on mean particle diameter. A very small fraction of finer materials (a small percentage of total materials) could travel downstream a greater distance before settling entirely to the stream bottom (assuming no resuspension), where the materials would ultimately continue to travel downstream as bedload. For example, in the minor perennial crossing type, a worst case estimate for transport of a fine silt fraction (diameter of 0.008 mm and settling velocity of 0.005 cm/sec) would give a maximum settling distance of about 1500 feet downstream. For the major perennial crossing type, this worst case settling distance would be over 20,000 feet downstream, assuming no intervening reservoirs and no induced settling by adsorption or aggregation with other particles.

Table 3. ESTIMATED INCREASE IN LEVEL OF SUSPENDED SOLIDS AT TYPICAL STREAM CROSSINGS.

Crossing Type	Distance Downstream (feet)	Suspended Solids (mg/l)
Major Perennial	50	8900
	100	3500
	200	3000
	500	80
	1000	3
	2000	<1
Minor Perennial	50	1200
	100	140
	200	3
	500	<1

An additional factor to be considered is the effect of turbulence in suspending, or resuspending particles discharged into the stream. It is reasonable to assume that no solids would remain suspended unless at least some of the turbulent eddies have upward velocity components exceeding the fall velocity of the solid (Bagnold 1966).

According to Bagnold (1954) the ratio of fall velocity, w, to shear velocity, v*, indicates whether sediment will be moved by bedload, via saltation, or as suspended particles. To evaluate this ratio, fall velocities for four classes of particles were determined: gravel and cobbles, sand, silt and clay. Shear velocities were determined for major and minor river crossings using the following equation:

$$v^* = v \sqrt{g} \frac{n}{1.49\,(R)^{1/6}}$$

where:

v^* = shear velocity
v = mean current velocity
g = gravitational constant
n = mannings number
R = hydraulic radius

Results indicate that suspension of fine silts and clays could occur in major rivers as a result of stream turbulence, assuming current velocities of 0.25 to 2.5 ft/sec. This size fraction is unlikely to be encountered for most of the crossings. However, if silty sands were encountered, the fraction of silt and clays present could remain suspended. Particles would eventually settle downstream inside pools, reaches of low stream velocity or downstream reservoirs. For a major river, with an assumed current velocity of 0.25 to 2.5 feet per second and background flow of 200 to 800 cfs, this suspended concentration is estimated to range from 1900 to 7800 mg/l.

Estimation of levels suspended in minor streams due to turbulence, using this methodology, cannot be accurately made because high suspended solids concentrations could increase fluid density, and correspondingly decrease shear velocity, e.g. the turbulence could be dampened by high suspended solids concentrations (Vanoni 1946 and Hino 1963).

Evaluation of Effects. Neither Colorado nor Wyoming has developed receiving water standards for suspended solids that would apply to the temporary disturbance during pipeline crossings (Squire 1981; Wagner 1981).

In order to assess the significance of these projected increases, therefore, available U.S. Geological Survey Water Resources Data (1957-80) have been assembled for streams that would be crossed. Table 4 indicates the range in level of suspended solids of these locations.

Construction disturbance would not be continuous, but temporary in nature. It is therefore meaningful to compare the estimated increase in suspended solids levels with the highest naturally occurring levels that occur on a temporary basis (usually during storm events). Although the data base is limited, Table 4 suggests that levels of suspended solids at major perennial rivers may presently exceed 10,000 mg/l. The highest temporary level in minor perennial streams may exceed 4000-6000 mg/l, although in certain smaller tributaries it may be less than 500 mg/l.

Because pipeline construction would not take place during periods of potential peak flow, the projected incremental increase due to construction activities would not be expected to increase levels above naturally occurring maximum levels, beyond 100 to 200 feet downstream

Table 4. RANGE IN RECORDED SUSPENDED SEDIMENT CONCENTRATIONS AT PERENNIAL RIVER CROSSINGS

Location	Gaging Station Number	Period of Record	Suspended Sediment (mg/1)
Stewart Gulch (at Mouth)	09306028	1975-76	97 to 2590
Stewart Gulch (Middle Fork)	09306050	1976	6 to 68
Piceance Creek (Below Rio Blanco)	09306007	1975-79	100 to 6500
Piceance Creek (At White River)	09306222	1972-78	36 to 5260
White River (Below Piceance)	000117	1972-80	<1 to 91,500
White River (At Rangely)	09306300	1972-80	17 to 43,400
Poison Spider Creek	06643900	1957-79	1040 to 4080
Sweetwater River	06639000	1975-80	4 to 242

of most perennial crossings. The majority of suspended sediments, generally sands or gravels for most crossings, would settle within 50-100 feet downstream, with measurable increases occurring up to about 200 to 500 feet downstream for minor crossings and 1000-2000 feet downstream for major crossings. A very small fraction of finer particles could travel up to perhaps 1500 and 20,000 feet downstream in minor and major streams, respectively, before settling entirely to the stream bottom. Particles maintained in suspension via turbulence would eventually settle in side pools, reaches of low current velocity and downstream reservoirs.

In conclusion, the effect upon surfacewater quality due to construction of the proposed and/or alternative stream crossings would be insignificant for the following reasons:

- Pipeline trench and fill activities would be temporary in nature and no permanent water quality alteration would occur.

- Existing short-term levels of suspended solids in many streams and rivers may already exceed the temporary level estimated to occur during pipeline construction. Beyond 100-200 feet, pipeline construction would not increase levels above naturally occurring maximums.

- The great majority of disturbed sediments would settle within short distances downstream.

<u>Hydrostatic Test Water Discharge</u>

<u>Hydrostatic Test Water Regulations</u>. The proposed trunkline and alternatives are within Region 8 of the U.S. Environmental Protection Agency (EPA). The discharge of pollutants from point sources,

including hydrostatic test water, into waters of the United States, would be unlawful without a permit issued under the National Pollutant Discharge Elimination System (NPDES). At this time uniform federal standards of performance for the discharge of hydrostatic test water have not been promulgated (Shanklin 1980). Authorization for the discharge of test water would be required from either the EPA (with concurrence of the state) or the individual authorized states. Administration of NPDES permits may be transferred to individual states, if authorized by the Administrator of the EPA. To date, both Wyoming and Colorado have been authorized to issue NPDES permits.

In Wyoming, authorization for discharge would be required from the Wyoming Department of Environmental Quality (DEQ). The DEQ policy is to prevent any surfacewater discharge, e.g., to dispose of test water on land via evaporation basins (Wagner 1981). If discharge was necessary, chemical analyses of test water to be used and locations and amounts of discharge would be required; detention ponds to reduce suspended solids levels may be required (Wagner 1981). In Colorado, authorization from the Colorado Department of Health would be required; no standard guidelines exist, but Colorado Basic Effluent Discharge Standards for total suspended solids (45 mg/l) oil and grease (10 mg/l and no visible sheen) and pH (6-9) may be required (Squire 1981).

<u>Hydrostatic Test Water Discharge</u>. During construction, the pipeline would be hydrostatically tested to 125 percent of maximum operating pressure. Water would be obtained from local ground or surfacewater supplies. The estimated maximum single discharge is 7.4 acre feet (2.4 million gallons).

As a result of hydrostatic testing, the levels of suspended solids, iron, grease and oil could potentially increase in the test

water. Table 5 presents a summary of water quality monitoring data collected before and after hydrostatic tests, using ground, surface, and municipal waters. As expected, the constituent showing the greatest increase is iron.

Without adequate treatment, the discharge of hydrostatic test water could increase the levels of turbidity, iron, oil and grease, and decrease the levels of dissolved oxygen in receiving waters. This would be especially significant in low flowing surface waters, which would have low assimilative capacities. Without adequate flow control, erosion could also occur at local discharge sites. For the highest volume of test water required (2.4 million gallons), uncontrolled (instantaneous) discharge over a short period could significantly increase local surface waters. For example, discharge of this volume over 8 hours would represent a continuous discharge exceeding 30 cubic feet per second. This level would exceed the annual average flow level of most rivers crossed except for the major perennial rivers.

<u>Summary of Effects</u>. The uncontrolled discharge of hydrostatic test water could increase surface water flows, potentially resulting in localized erosion. Levels of suspended solids, grease, oil, and iron could temporarily increase downstream of discharge sites. Depending upon the specific discharge location, downstream uses, including recreation, aquatic habitat, or municipal water supply could be temporarily impaired.

In order to prevent these potential effects, and to meet Colorado and Wyoming permit requirements, the following mitigation would be required:

Table 5. HYDROSTATIC TEST WATER ANALYSES

Parameter	Water Source: Pond		Well		Creek		River		Municipal	
	Fill	Dewater	Fill	Dewater	Fill	Dewater	Fill	Dewater	Fill	Dewater
Fe (mg/l)	0.56	13.2	0.2	14.0	1.3	1.3	0.2	2.6	2.7	0.4
TSS (mg/l)	69	61	8	120	–	–	–	–	–	–
SO_4(mg/l)	17	142	–	–	–	–	26.8	30.3	8.0	7.2
Cl (mg/l)	0.8	0.7	–	–	–	–	52.5	36.0	4.0	3.0
F (mg/l)	0.4	0.4	–	–	–	–	0.4	0.4	1.1	1.1
COD (mg/l)	68.0	34.0	1.0	1.0	38.0	10.0	–	–	–	–
Hardness (mg/l)	64.0	60.0	–	–	–	–	48.0	40.0	26.0	26.0
Alkalinity (mg/l)	78.0	58.0	–	–	–	–	26.0	20.0	18.0	18.0
pH	7.3	7.3	7.7	7.9	5.8	6.3	6.9	6.6	7.6	7.5

Source: Young 1980.

- Wherever possible, hydrostatic test water should be disposed of on land, via evaporation pits or basins, with no surface-water discharge.

- If surface water discharge is necessary, watercourses with the greatest background flow (and assimilative capacity) should be selected.

- To prevent erosion at discharge sites, test water should be released slowly, such that background flow levels are not significantly increased, e.g., beyond 5-10 percent.

- Water should be discharged horizontally into a discharge diffuser pipe, to minimize flow velocity and prevent potential scour effects.

- Water should be routed through detention basins prior to discharge to reduce the levels of suspended solids and iron.

- If grease and oil are present, water should be routed through one or more straw bale filters, in sequence, to reduce concentrations to acceptable levels.

Flooding

Executive Order 11988 requires that federal agencies give special consideration to avoidance of facilities that can be damaged by floodwaters within a 100-year floodplain. Proposed surface facilities include four pump stations, which would be sited within designated areas along the proposed trunkline route. The Parachute pump station would be located over 50 feet in elevation above the nearest watercourse, which is a steep intermittent draw; therefore, flooding during the 100-year storm would not affect this site. The Maybell pump

station would be located above Highway 40, which would provide this highway's design level of flood protection from the Yampa River. The Maybell pump station could be subject to flashflooding of Deception Creek, depending on where the pump station were sited within the specified area. It appears that sufficient elevation exists within the western portion of the area to locate the station above the 100-year floodplain, however. The Baggs pump station would be located above Highway 789, and a local secondary road, which would provide protection from the Little Snake River and Muddy Creek. The Rawlins pump station would be located in the flat plain drained by Separation Creek. A 100-year flash flood could affect this station, albeit at a very low flood stage, depending upon specific location and station design parameters.

In the case of both the Maybell and Rawlins pump stations, provision of 100-year flood protection could likely be accomplished with a minimum of difficulty, e.g., by location at higher elevation within the siting area or by elevation of the pump station pad. The final project design will include an estimation by La Sal of the 100-year flood stage elevations and all stations will be sited above that level. Therefore, no further consideration will be given to potential flooding effects.

The proposed trunkline and/or alternatives would cross the floodplains of numerous rivers. In accordance with Department of Interior regulatory stipulations for stream and floodplain crossings, the depth of channel scour would be established by appropriate field investigations and theoretical calculations, using those combinations of water velocity and depth that yield the maximum value. At the point of maximum scour (maximum scour depth elevation) the cover over the pipe would be at least 20 percent of the computed scour, but not less than four feet. Therefore, no detailed analysis of potential pipe failure due to flood scour is necessary.

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LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

VEGETATION BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
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LA SAL PIPELINE PROPOSAL
VEGETATION (INCLUDING AGRICULTURE)
BACKGROUND REPORT

AFFECTED ENVIRONMENT

Trunkline

Vegetation Types. Seven vegetation types totaling approximately 3381 acres (100-foot right-of-way [ROW] by 279 miles) would be disturbed along the proposed trunkline (Table 1). An additional 8 acres would be disturbed for work areas at major river crossings. The sagebrush/grassland vegetation type occurs along approximately 158 miles of the proposed trunkline route and is the dominant vegetation type associated with the proposed trunkline action. Forest vegetation types, other than a limited amount of pinyon-juniper, do not occur in the immediate vicinity of the proposed trunkline.

Numerous publications and vegetative type maps are available for the region adjacent to the proposed action. A number of the more pertinent sources include:

- United States Bureau of Land Management (BLM) 1980, 1979a, 1979c, 1978a, 1978c, 1977.
- Cb Shale Oil Venture, 1977.
- Thorne Ecological Institute, 1974.

Table 1. DISTRIBUTION OF VEGETATION ALONG THE PROPOSED TRUNKLINE ROUTE

	Milepost	Miles Traversed	Vegetation Type
	0-10	10.0	Mountain Shrub
	10-16	16.0	Pinyon-Juniper
C	16.0-16.5	.5	Agriculture
O	16.5-37.0	20.5	Pinyon-Juniper
L	37.0-37.5	.5	Agriculture
O	37.5-60.0	22.5	Pinyon-Juniper
R	60.0-70.0	10.0	Sagebrush/Grassland
A	70-70.5	.5	Agriculture
D	70.5-72.0	1.5	Riparian (Yampa)
O	72.0-80.0	8.0	Riparian (Spring Creek)
	80.0-109.0	29.0	Sagebrush/Grassland
	109.0-110.0	1.0	Agriculture
	110.0-110.5	.5	Riparian
	110.5-180.0	69.5	Sagebrush/Grassland
W	180-195.0	15.0	Desert Shrub
Y	195-230.0	35.0	Sagebrush/Grassland
O	230-234.0	4.0	Plains Grassland
M	234-234.5	.5	Riparian
I	234.5-243.0	8.5	Plains Grassland
N	243.0-243.5	.5	Riparian
G	243.5-259.0	15.5	Plains Grassland
	259.0-259.5	.5	Riparian
	259.5-263.0	3.5	Plains Grassland
	263.0-278.6	15.6	Sagebrush/Grassland

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Mountain Shrub. The mountain shrub vegetation type occurs from the pipeline origination near Davis Gulch to milepost (MP) 10. Major plant species include shrubs such as service berry, mountain mahogany, chokecherry, and gambel oak in association with grasses such as wheatgrasses, bromegrasses (Genus *Bromus*), and bluegrass. Pockets of douglas fir and aspen are interspersed throughout the type and occur mainly on north slopes and in other mesic locations. The mountain shrub type generally occurs at intermediate elevations, i.e., 7,000-8,500 feet, above the pinyon-juniper zone and below the woodlands of the lower mountains.

Pinyon-Juniper Woodland. The proposed trunkline ROW traverses approximately 39 miles of pinyon-juniper woodland. The pinyon-juniper type is common from MP 16-60, throughout the Piceance and White River drainage basins. The type frequently occupies eroded and rough sites on plateaus, terraces and ridgetops between elevations of 6,000 and

7,500 feet. Pinyon and juniper trees form a dense to open woodland, with the density of shrubs and herbs dependent primarily on the extent of tree canopy. Dominant plant species include pinyon pine and juniper along with other shrubs and grasses such as sagebrush, snakeweed, galleta, and Indian ricegrass. This vegetation type typically provides forage at the rate of about 20 acres per animal unit month (AUM).

Sagebrush/Grassland. The sagebrush/grassland type occurs along approximately 150 miles of the proposed trunkline route and is the dominant type between MP 80 and 180 and again on the extreme northern end of the route. The sagebrush/grassland type is characterized by shrubs, principally of the genus Artemesia, although other shrubs (e.g., rabbitbrush, bitterbrush, shadscale, winterfat, and saltbush) may be associates. Various species of wheatgrasses, fescue, bluegrass, and bromegrasses (Genus Bromus) are frequently common in the understory. About 10 acres of forage per AUM is typical for this vegetative type.

Desert Shrub. Desert shrub is the dominant vegetation type between MP 180 and 195. The vegetation of this type is generally characterized by xeric shrubs varying in height from 4 inches to several feet. Common shrubs include several species of saltbushes, rabbitbrush, and greasewood. These shrubs frequently occur as open stands with Indian ricegrass and galleta as common constituents of the sparse under-story. This vegetation type typically provides forage at the rate of about 30 acres per AUM.

Plains Grassland. The plains grassland type occurs along the northern end of the proposed trunkline, between MP 230 and 263. Short, warm season grasses predominate in this type, and there is

a minor component of forbs and shrubs. Dominant grasses are blue gramma and buffalo grass; other species include sideoats grama, black grama, bluestems and sand dropseed. Occasional shrubs include juniper, sagebrush, silver buffaloberry and skunkbush sumac. Forbs are generally common but are usually ephemeral.

Riparian. Riparian vegetation is associated with most of the river crossings along the proposed trunkline route. The extent of the riparian vegetation is generally limited to a small band on either side of each river. Cottonwood and willow are the most common native riparian tree species. Other common species include various sedges, mesic grasses, juncus, salt grass, alkali sacaton, and greasewood. The valleys and floodplains adjacent to the rivers are generally used for various agricultural purposes.

Although riparian habitat is generally limited along the remainder of the proposed trunkline route, approximately eight miles of the type is paralleled by the pipeline between MP 72.0 and 80. Dominant species at this location include: willow, sedges, saltgrass, juncus, and alkali sacaton.

An additional 7-1/2 to 8 acres of riparian vegetation would be disturbed at the three major river crossing work areas (White, Yampa, and Little Snake).

Agriculture. Agricultural lands are present along approximately 2.5 miles (30 acres) of the proposed trunkline route. These lands are scattered along the route, particularly near major river and stream crossings. Agricultural lands are discussed under Land Uses.

Endangered and Threatened Species. Endangered and threatened species information is contained in the Biological Assessment.

Pump Stations

The four pump stations associated with the proposed trunkline would be located within the vegetation types previously described for the proposed trunkline. The location of each pump station, type of vegetation removed and acreage is listed in Table 2.

Alternatives

Southern Rangely Lateral Alternative. The Southern Rangely Lateral Alternative traverses four vegetation types including: pinyon-juniper, agricultural/riparian, mountain shrub, and desert shrub. Each of these types has been discussed in the trunkline section. The distribution of these types along this lateral alternative route is listed in Table 3.

Northern Rangely Lateral Alternative. The Northern Rangely Lateral Alternative traverses five vegetation types including: pinyon-juniper, sagebrush/grassland, riparian, agriculture and desert shrub. Each of these has been discussed in the section for the proposed trunkline route. The distribution of types along this lateral alternative route is listed in Table 4.

White and Yampa River Alternatives. The vegetation type(s) along the White River and Yampa River alternatives are similar to those existing along the proposed trunkline. These are described in the trunkline section above. The distribution of vegetation along these two alternatives is presented in Table 5.

ENVIRONMENTAL CONSEQUENCES

Analytic Criteria

To quantify and determine the level of significance of impacts associated with this project, two criteria were used:

Table 2. ACREAGE BY VEGETATION TYPE FOR AREAS DISTURBED BY PUMP STATIONS

Milepost	Pump Station Acreage	Vegetation Type
0.0	10	Mountain Shrub
71.0	3	Sagebrush/Grassland
116.0	3	Sagebrush/Grassland
188.0	3	Desert Shrub

Table 3. DISTRIBUTION OF VEGETATION ALONG THE SOUTHERN RANGELY LATERAL ALTERNATIVE

Milepost	Miles Traversed	Vegetation Type
0-6.5	6.5	Pinyon-Juniper
6.5-7.0	0.5	Agricultural/Riparian
7.0-24	17.0	Pinyon-Juniper
24-25	1.0	Mountain Shrub
25-36	11.0	Pinyon-Juniper
36-41.5	5.5	Desert Shrub

Table 4. DISTRIBUTION OF VEGETATION ALONG THE NORTHERN RANGELY LATERAL ALTERNATIVE

Milepost	Miles Traversed	Vegetation Type
0-15	15.0	Pinyon-Juniper
15-25.5	10.5	Sagebrush/Grassland
25.5-26.0	0.5	Agriculture
26.0-30	4.0	Pinyon-Juniper
30.0-35.4	5.4	Desert Shrub

Table 5. DISTRIBUTION OF VEGETATION ALONG THE WHITE RIVER AND YAMPA RIVER ALTERNATIVES

Milepost	Miles Traversed	Vegetation Type
White River Alternative		
0.0-9.5	9.5	Pinyon-Juniper
9.5-10.0	0.5	Agriculture
10.0-16.0	6.0	Pinyon-Juniper
Yampa River Alternative		
0-22.5	22.5	Sagebrush/Grassland
22.5-23.0	0.5	Agriculture/Riparian
23.0-25.0	2.0	Sagebrush/Grassland
25.0-27.0	2.0	Pinyon-Juniper
27.0-38.0	11.0	Sagebrush

1) Each vegetative type identified through data compilation was analyzed to determine the relative extent of disturbance which is expected to result from the proposed action (Tables 6-9). If no more than one percent of the total type within the geographic area (generally a 20-mile wide corridor) is expected to be disturbed by the proposal, then the significance of that impact is considered to be low. If it was determined that more than one percent of the total would be disturbed, the impact analysis was conducted in further depth to identify the duration and significance of the disturbance.

2) This criterion was applied if a finding of significance was made from criterion 1 (greater than one percent disturbance). When the amount of disturbance was found to be greater than one percent, further analysis determined whether the nature of disturbance would create beneficial or adverse impacts as well as short-term or long-term impacts to the vegetation type. For purposes of this determination, the following definitions were employed.

   Short term: High probability of establishing perennial vegetation, i.e., well developed roots and crowns for species such as perennial grasses, within 3 years of the initial disturbance and a high probability for recovery of pre-existing vegetation within 5 years of initial disturbance.

   Long term: Low probability of establishing perennial vegetation, i.e., same as above, within 3 years of the initial disturbance and low probability for recovery of pre-existing vegetation within 5 years of initial disturbance.

Table 6. ESTIMATED ACREAGE DISTURBED BY CONSTRUCTION OF THE PROPOSED TRUNKLINE AND ESTIMATED ACREAGE WITHIN THE REGION[a] OF THE TRUNKLINE

	Vegetation Type[b]	Mile-post	Number Miles	Acres Disturbed	Approximate Acres in Region[a]	Percentage Disturbed
	MS	0-10	10.0	121	128,000	<1
	PJ	10-16	6.0	73	76,800	<1
C	Ag	16-16.5	0.5	6	6,400	<1
O	PJ	16.5-37	20.5	248	196,800	<1
L	Ag	37.-37.5	0.5	6	6,400	<1
O	PJ	37.5-60	22.5	273	187,200	<1
R	S/G	60-70	10.0	121	102,400	<1
A	Ag	70-70.5	0.5	6	6,400	<1
D	R (Yampa)	70.5-72	1.5	18	12,800	<1
O	R (Spring)	72-80	8.0	97	640	>1
	S/G	80-109	29.0	352	361,000	<1
	Ag	109-110	1.0	12	12,800	<1
	R	110-110.5	0.5	6	6,400	<1
	S/G	110.5-180	69.5	842	710,000	<1
	DS	180-195	15.0	182	48,000	<1
W	S/G	195-230	35.0	424	224,000	<1
Y	PG	230-234	4.0	48	30,720	<1
O	R	234-234.5	0.5	6	6,400	<1
M	PG	234.5-243	8.5	103	97,920	<1
I	R	243-243.5	0.5	6	6,400	<1
N	PG	243.5-259	15.5	188	99,200	<1
G	R	259-259.5	0.5	6	6,400	<1
	PG	259.5-263	3.5	42	13,400	<1
	S/G	263-278.6	15.6	189	84,000	<1

[a]Region considered to be a 20-mile corridor centered on the proposed trunkline.

[b]Vegetation Types: MS - Mountain Shrub; PJ - Pinyon-Juniper; Ag - Agriculture; S/G - Sagebrush/Grassland; R - Riparian; DS - Desert Shrub; PG - Plains Grassland.

Table 7. ACREAGE BY VEGETATION TYPE FOR AREAS DISTURBED BY AND WITHIN THE REGION[a] OF PUMP STATIONS

Vegetation Type[b]	Mile-post	Acres Disturbed	Approximate Acres in Region[a]	Percentage Disturbed
MS	0.0	10	160,849	<1
S/G	71.0	3	180,955	<1
S/G	116.0	3	160,849	<1
DS	188.0	3	80,424	<1

[a]Region considered to be the area within a 10-miles radius of the pump station location.

[b]Vegetation Types: MS - Mountain Shrub; S/G - Sagebrush/Grassland; DS - Desert Shrub.

Table 8. ESTIMATED ACREAGE DISTURBED BY CONSTRUCTION OF THE RANGELY LATERALS AND ESTIMATED ACREAGE WITHIN THE REGION[a] OF THE LATERALS

Vegetation Type[b]	Mile-post	Number Miles	Acres Disturbed	Approximate Acres in Region[a]	Percentage Disturbed
Southern Rangely Lateral Alternative					
PJ	0-6.5	6.5	79	83,200	<1
Ag/R	6.5-7	0.5	6	6,400	<1
PJ	7-24	17.0	206	120,000	<1
MS	24-25	1.0	12	12,800	<1
PJ	25-36	11.0	133	74,880	<1
DS	36-41.5	5.5	67	24,640	<1
Northern Rangely Lateral Alternative					
PJ	0-15	15.0	182	153,600	<1
S/G	15-25.5	10.5	127	64,000	<1
Ag	25.5-26	0.5	6	6,400	<1
PJ	26-30	4.0	48	5,120	<1
DS	30-35.4	5.4	65	58,240	<1

[a]Region considered to be a 20-mile corridor centered on the Rangely lateral alternative routes.

[b]Vegetation Types: MS - Mountain Shrub; PJ - Pinyon-Juniper; Ag - Agriculture; S/G - Sagebrush/Grassland; R - Riparian; DS - Desert Shrub.

Table 9. ESTIMATED ACREAGE DISTURBED BY CONSTRUCTION OF THE WHITE AND YAMPA RIVER ALTERNATIVES AND ESTIMATED ACREAGE WITHIN THE REGION[a] OF THE ALTERNATIVES

Vegetation Type[b]	Mile-post	Number Miles	Acres Disturbed	Acres in Region[a]	Percentage Disturbed
<u>White River Alternative</u>					
PJ	0-9.5	9.5	115	121,600	<1
Ag	9.5-10	0.5	6	6,400	<1
PJ	10-16	6.0	73	76,800	<1
<u>Yampa River Alternative</u>					
S/G	0-22.5	22.5	273	172,800	<1
Ag/R	22.5-23	0.5	6	6,400	<1
S/G	23-25	2.0	24	23,040	<1
PJ	25-27	2.0	24	20,480	<1
S/G	27-38	11.0	133	112,640	<1

[a]Region considered to be a 20-mile corridor centered on the alternatives.

[b]Vegetation Types: PJ - Pinyon-Juniper; Ag - Agriculture; S/G - Sagebrush/Grassland; R - Riparian.

If it was determined that impacts would be adverse and long-term, then the significance of that impact is considered high.

Endangered and Threatened. Endangered and threatened plant species are being considered on a case-by-case basis as part of the U.S. Fish and Wildlife Service Section 7 Consultation. All findings and determination of effects will be discussed (when available) in the Biological Assessment.

Trunkline Construction Impacts

Criterion 1 Results. Results of applying criterion 1 (Table 6) indicate that greater than one percent of the regional vegetation may be disturbed in one area of the proposed action. This area is located between MP 72.0 - 80.0 and is characterized by riparian vegetation associated with Spring Creek.

Criterion 2 Results. Results of applying criterion 2 to the area of riparian vegetation between MP 72 - 80 indicates that potential impacts would be significant. Impacts are likely to be adverse and long-term based on the following factors:

- Revegetation with standard perennial grass mixtures would probably prevent erosion and allow for normal succession to occur, but many existing species associated with the riparian habitat would not become reestablished within 5 years.

- Impacts would be adverse for most wildlife species that depend on the existing riparian vegetation for daily and seasonal habitat requirements.

Generalized Impacts. Construction of the proposed 279-mile trunkline would disturb an estimated 3381 acres, or about 5.3 square miles, of vegetation. Vegetation would be removed from as much of the

100-foot ROW as required to allow sufficient work space for machinery and vehicles.

Approximately 65 percent of the proposed trunkline would follow existing rights-of-way. The paralleling of existing rights-of-way where possible should substantially lessen the indirect impacts when compared to a similar ROW through previously undisturbed vegetation types.

Eight major vegetation types would be affected with approximately 1900 acres (57 percent) of the vegetation disturbance being confined to sagebrush. About 384 acres (11 percent) of the vegetation disturbance would occur in grasslands, 578 acres (17 percent) in pinyon-juniper areas, and about 139 acres (4 percent) in riparian vegetation.

Vegetation disturbances would occur primarily during the peak of construction work. Reclamation procedures along the ROW would begin on virtually all of the disturbed area immediately after construction is completed at each work site. Vegetation reestablishment would take from one to over 50 years, depending on local conditions and the existing vegetation type. Agricultural areas disturbed along the ROW (30 acres) could be returned to productivity the year following construction. On the remaining acreage to be reclaimed, herbaceous species would begin to appear on disturbed areas within one to two years. Seedlings of woody species such as shrubs and trees (depending on the preconstruction vegetation type), could appear in about three to five years but may take five to 15 years (for shrubs) or over 50 years (for trees), to grow to heights resembling similar species in adjacent undisturbed areas (Wagner et al. 1978; Shantz 1917).

Revegetation of areas disturbed during pipeline construction should be most successful in the grassland vegetation type since

herbaceous species are dominant and typically grow to maturity in only one to two years. Revegetation would be least successful on areas along the pipeline route where local conditions (e.g., limited topsoil horizon, high salt content, etc.) may have resulted in an extremely sparse vegetative cover, e.g., desert shrub, prior to construction. In such areas, it is probable that any vegetation reestablishment may also be sparse.

The potential for natural revegetation of the ROW is generally high since surface soil disturbances would not be severe in most areas. Also, the narrow width of the ROW would likely enhance the establishment of plant species from adjacent undisturbed areas. The degree of natural establishment of native plants in a disturbed area by seed dispersal and/or rhizomes and spreading roots is related in part to the ratio of the perimeter to the local area of disturbance. A large perimeter in relation to area, as would be the case with the pipeline ROW, provides a larger number of plants as potential sources for seeds, rhizomes, and spreading roots.

In addition to a change in plant species composition, removal of vegetation along the pipeline ROW would cause only a slight reduction in the overall vegetation biomass and annual productivity of the region. This reduction is expected to be quite small due to the narrow width of the ROW, which would be cleared in comparison to the extensive coverage of most of the vegetation types involved.

Construction of the pipeline would result in the removal of aquatic vegetation that may exist at river and stream crossings. The disturbance would be limited to a rather small area at each crossing. In addition, the removal of terrestrial and riparian vegetation during construction would also have an indirect effect on aquatic vegetation in streams as a result of increased erosion. The effect of construction on aquatic vegetation at various crossings is expected to be

quite limited due to the small area involved and the relatively small amount of sediment generated at the construction site that would be carried downstream.

Vehicular emissions during construction and fugitive dust during and after construction would settle on vegetation in adjacent undisturbed areas but is not expected to cause any discernible changes to the species composition, biomass, or annual productivity of adjacent vegetation (Reed et al. 1976).

Trunkline Operation Impacts

Operation and maintenance of the pipeline system would require no additional removal of vegetation. Routine inspections would be conducted by aircraft. Vegetation would be disturbed only during valve maintenance or pipeline repair. Thus, operational impacts to vegetation along the ROW are expected to be negligible.

Clearing of the ROW will make some areas more accessible to off-road vehicle activity. Continued use of the ROW by off-road vehicles could result in additional destruction of vegetation as well as hindrance of the revegetation process. These vegetation losses are expected to be quite small since most of the pipeline route parallels existing utility corridors rather than crossing previously inaccessible areas. The presence of existing gates and fences is also expected to reduce off-road vehicle travel along the ROW.

Pump Stations

Construction Impacts.

Criterion 1 Results. No pump stations will result in disturbance to more than one percent of the regional vegetation (Table 7).

Criterion 2 Results. N/A

Generalized Impacts. Construction of the four pump stations would remove approximately:

10 acres	of Mountain Shrub	at MP 0.0
3 acres	of Sagebrush/Grassland	at MP 71.0
3 acres	of Sagebrush/Grassland	at MP 116.0
3 acres	of Desert Shrub	at MP 188.0

The reduction in vegetative biomass and annual productivity due to construction of the pump stations is considered insignificant compared to total productivity in the region.

Operation Impacts. Vegetation removed during construction of pump stations would be lost for the operational life of the pipeline. As a result, operation impacts would be similar to construction impacts but would be long-term.

Alternatives

Rangely Lateral Alternatives.

Criterion 1 Results. Results of applying criterion 1 to vegetation types along the Rangely lateral alternatives indicate that no area will be significantly affected during the construction phase of the project (Table 8).

Criterion 2 Results. N/A

Generalized Impacts. Construction of the proposed 41.5 mile long Southern Rangely Lateral Alternative would disturb an estimated

503 acres, or about .8 square miles of vegetation. Approximately 17 percent of this lateral alternative would parallel existing rights-of-way.

Construction of the 35.4 mile long Northern Rangely Lateral Alternative would disturb an estimated 429 acres, or about .7 square miles of vegetation. Approximately 66 percent of the Northern Rangely Lateral Alternative route would parallel existing rights-of-way.

Vegetation disturbances would occur primarily during the peak of construction. Reclamation procedures along the rights-of-way would begin on virtually all of the disturbed area immediately after construction.

One major river crossing would occur on the southern alternative (White River) and one river crossing would occur on the northern alternative (White River), thus disturbing approximately 6 acres of agricultural/riparian vegetation on each lateral alternative.

The impacts, revegetation and reduction in overall vegetation biomass and annual productivity are expected to be similar to those previously discussed for the proposed trunkline.

Operation Impacts. Impacts due to operation and maintenance of the Rangely lateral alternatives would be similar to those discussed for the proposed trunkline.

White and Yampa River Alternatives. Construction impacts for the White and Yampa River alternatives would be as follows:

Criterion 1 Results. The results of applying Criterion 1 (no more than one percent disturbance) to the vegetation type(s) along

the White River and Yampa River alternative routes indicate that no area would be affected by one percent (Table 9); therefore, construction is not expected to have a significant impact along any of the alternatives.

Criterion 2 Results. Criterion 2 was not applied since no segment of any vegetation type was disturbed by as much as one percent.

Generalized Impacts. In general, the impacts would be similar along these two alternatives and would be similar to those described for the proposed trunkline. A comparison of the acreage disturbed by vegetation type is presented in Table 10. The only significant difference between these two alternatives and the proposed trunkline occurs near the Yampa River crossing. In this area, the Yampa River Alternative would not disturb crucial riparian vegetation along Spring Creek and the proposed trunkline route would disturb approximately 96 acres.

Operation Impacts. Impacts associated with the operation and maintenance of these two alternatives are expected to be similar regardless of the alternative and would be similar to those described for the proposed trunkline.

Table 10. SUMMARY OF BIOLOGICAL INFORMATION OF THE PROPOSED ACTION AND ALTERNATIVES

Information for Comparison	Southern Rangely Lateral Alternative	Northern Rangely Lateral Alternative	White River Proposed	White River Alternative	Yampa Proposed (Including Pump Station)	Yampa Alternative (Including Pump Station)
COMPARISON OF VEGETATION DISTURBED (Acres)						
Desert Shrub	67	78				
Pinyon-Juniper	394	231	127	188	120	24
Sagebrush/Grassland		156			181	433
Riparian	3				115	3
Agriculture	3	6	6	6	6	3
Mountain Shrub	12					
ESTIMATED NUMBER OF THREATENED AND ENDANGERED SPECIES LIKELY TO OCCUR	0	1	1	1	1	2
NUMBER OF ACRES OF CRUCIAL WILDLIFE HABITAT DISTURBED (Percent of Total)[a]						
Mule Deer Critical Winter Range	200 (>1%)		30 (<1%)	157 (<1%)	264 (<1%)	173 (<1%)
Elk Critical Winter Range						12.1 (<1%)
Sage Grouse Strutting/ Brooding Grounds	24.2 (<1%)				48 (<1%)	97 (<1%)
Sage Grouse Winter Concentration Area	8.5 (<1%)					
Crucial Riparian Habitat					96 (<15%)	
Golden Eagle Nests (Number)	(3)	(4)		(2)	(2)	
Bald Eagle Winter Concentration		Entire Corridor				

[a]Percent of the total regional resource.

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LA SAL PIPE LINE COMPANY
SHALE OIL PIPELINE PROPOSAL
ENVIRONMENTAL IMPACT STATEMENT

WILDLIFE
BACKGROUND DOCUMENTATION REPORT

for

Colorado State Office
Bureau of Land Management
Department of the Interior

Woodward-Clyde Consultants
Three Embarcadero Center, Suite 700, San Francisco, CA 94111

LA SAL PIPELINE PROPOSAL
WILDLIFE BACKGROUND REPORT

AFFECTED ENVIRONMENT

Proposed Trunkline

Some wildlife species show an affinity for certain plant associations, soil types, and topographic features (e.g., cliffs, canyons, etc.), while other species range over rather large areas that may encompass several vegetative associations. The presence of wildlife species may not only be dependent upon the quantity and quality of the habitat available but also on the human activity associated with that habitat. For example, in areas where the proposed trunkline route parallels existing corridors or heavily utilized roads, species that are generally displaced by human disturbance, e.g., elk or nesting raptors, may be rare.

The major wildlife habitats, the approximate lengths they extend along the proposed trunkline route, and several generally common species associated with each are as follows:

- Shrublands (including sagebrush and desert shrub): 173 miles; mule deer, coyote, gray fox, long-tailed weasel, valley pocket gopher, white-tailed jackrabbit, golden-mantled ground squirrel, turkey vulture, golden eagle, marsh hawk, sage grouse, horned lark, black-billed magpie, American robin, western meadowlark.

- Mountain Shrub (including aspen and douglas fir stands): 10 miles; mule deer, elk, coyote, gray fox, bobcat, long-tailed weasel, meadow vole, golden-mantled ground squirrel, golden eagle, red-tailed hawk, blue grouse.

- Plains Grasslands: 31.5 miles; Pronghorn antelope, coyote, valley pocket gopher, desert cottontail, turkey vulture, golden eagle, marsh hawk, horned lark, black-billed magpie, red-winged blackbird.

- Pinyon-Juniper Woodlands: 39 miles; mule deer, coyote, gray fox, long-tailed weasel, white-tailed woodrat, white-tailed jackrabbit, golden-mantled ground squirrel, turkey vulture, golden eagle, black-throated gray warbler.

- Riparian: 11.5 miles; Mule deer, coyote, red fox, gray fox, raccoon, turkey vulture, red-tailed hawk, golden eagle, ring-necked pheasant, great-horned owl, cliff swallow, black-billed magpie, American robin, starling, yellow-rumped warbler.

- Agriculture: 2.5 miles; coyote, raccoon, long-tailed weasel, valley pocket gopher, turkey vulture, red-tailed hawk, marsh hawk, ring-necked pheasant, great-horned owl, cliff swallow, black-billed magpie, American robin, starling, western meadowlark, red-winged blackbird.

The species listed above will vary considerably in abundance and density depending upon such factors as vegetative composition, vegetative life form, micro-climate, etc. General lists of wildlife species present are available in various publications and are frequently available from state and regional offices of the Fish and Game or

Wildlife Resource Divisions and the Bureau of Land Management (BLM) District Offices. A number of publications that provide general information relative to wildlife densities by vegetation type, status of certain wildlife species, and range of various species are available (Bissel 1978; Colorado Division of Wildlife (CDOW) 1978a; Dorn 1978; Kingery and Graul 1978; Langlois 1978; Rothwell et al. 1978; Roughton and Sweeney 1978; Wyoming Game and Fish Department (WGFD) 1977.

Several species or species groups are of particular concern, such as big game species, game birds, waterfowl, raptors, sensitive spesies* and endangered and threatened species. Generally, a rather high amount of public interest and public funds as well as legislative protection are directed toward such species and concern arises if any could be affected by a proposed action. These concerns have been raised in literature and through contacts (CDOW 1979a and 1978c; WGFD 1979 and 1978). These species or species groups and crucial wildlife habitats (Table 1) are discussed below.

Large Mammals. Mule deer, pronghorn antelope, elk, and wild horses are the major big game and large animal species that occur along or near the proposed trunkline route. Mule deer are the most widespread of the large mammals occurring throughout a large portion of the route with year-long, summer, and winter ranges being rather extensive. Several mule deer fawning and crucial winter range areas are traversed

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*Sensitive species include those receiving management priority by the BLM. These species are included on such lists as the Migratory Birds of Federal High Interest and the Colorado Resident Species of High Interest.

Table 1. CRITICAL/CRUCIAL WILDLIFE HABITAT DISTURBANCE EXPECTED TO RESULT FROM THE PROPOSED TRUNKLINE

Milepost	Critical/Crucial Wildlife Use Areas	Estimated Acreage In Region[a]	Estimated Acreage Disturbed	Percent Disturbed
0.0 - 4.0	Elk critical winter range	19,164	48.5	<1.0
0.0 - 3.0	Mule deer fawning area	41,788	36.4	<1.0
3.0 - 6.5	Sage grouse brooding grounds	8,673	42.4	<1.0
4.5 - 11.0	Elk critical winter range	8,022	78.8	.98
4.5 - 5.0	Sage grouse brooding grounds	126	6.1	4.8
6.5 - 9.0	Blue grouse brooding grounds	24,605	30.3	<1.0
7.0 - 7.5	Sage grouse strutting grounds	432	6.1	1.4
12.0 - 15.5	Mule deer critical winter range	14,985	42.4	<1.0
14.5	Golden eagle nest	N/A	N/A	N/A
17.0 - 19.0	Mule deer critical winter range	24,097	24.2	<1.0
19.5 - 20.5	Sage grouse breeding complex	2,597	12.1	<1.0
23.0 - 27.0	Mule deer critical winter range	24,097	48.5	<1.0
30.0 - 35.5	Mule deer critical winter range	22,349	66.7	<1.0
31.5	Golden eagle nest	N/A	N/A	N/A
37.0	Bald eagle perching/roost site	N/A	N/A	N/A

Table 1. (continued)

Milepost	Critical/Crucial Wildlife Use Areas	Estimated Acreage In Region[a]	Estimated Acreage Disturbed	Percent Disturbed
51.5 - 56.5	Mule deer critical winter range	52,566	60.6	<1.0
58.0 - 62.0	Sage grouse strutting grounds	17,723	48.5	<1.0
69.0 - 82.0; 107.0-115.5	Mule deer critical winter range	320,677	260.6	<1.0
72.0 - 80.0	Crucial riparian habitat	640	97.0	15
76.0 - 80.0	Sage grouse strutting grounds	17,580	48.5	<1.0
77.0	Golden eagle nest	N/A	N/A	N/A
78.0	Golden eagle nest	N/A	N/A	N/A
88.0 - 91.0	Sage grouse breeding complex	8,738	36.4	<1.0
91.0 - 94.0	Sage grouse brooding grounds	24,412	36.4	<1.0
96.0 - 103.0	Sage grouse brooding grounds	20,024	84.8	<1.0
107.0 - 109.5	Sage grouse brooding grounds	19,309	30.3	<1.0
109.0 - 111.0	Bald eagle foraging and roosting area	N/A	N/A	N/A
130.0	Prairie falcon nest	N/A	N/A	N/A
132.0	Golden eagle nest	N/A	N/A	N/A
132.5	Prairie falcon nest	N/A	N/A	N/A

Table 1. (concluded)

Milepost	Critical/Crucial Wildlife Use Areas	Estimated Acreage In Region[a]	Estimated Acreage Disturbed	Percent Disturbed
132.5 - 137.5	Ferruginous hawk nesting area	N/A	N/A	N/A
140.5 - 148.0	Ferruginous hawk nesting area	N/A	N/A	N/A
142.5	Prairie falcon nest	N/A	N/A	N/A
142.5	Golden eagle nest	N/A	N/A	N/A
143.5 - 145.0	Sage grouse breeding complex	26,836	18.2	<1.0
150.0 - 153.0	Sage grouse breeding complex	21,957	36.4	<1.0
158.0 - 161.5	Sage grouse breeding complex	16,070	42.4	<1.0
162.5 - 165.5	Sage grouse breeding complex	7,152	36.4	<1.0
169.0 - 171.0	Ferruginous hawk nesting area	N/A	N/A	N/A
190.0	Golden eagle nest	N/A	N/A	N/A
195.0 - 198.0	Sage grouse breeding complex	8,416	36.4	<1.0
212.5 - 217.5	Deer and elk critical winter range	3,781	60.6	<1.0
214.0	Prairie falcon nest	N/A	N/A	N/A
223.0	Golden eagle nest	N/A	N/A	N/A
239.5 - 246.0	Antelope critical winter range	38,107	78.8	<1.0
247.0 - 250.5	Sage grouse breeding complex	31,738	42.4	<1.0
251.0 - 253.0	Mule deer critical area	45,355	24.2	<1.0
251.5 - 257.0	Sage grouse breeding complex	13,132	66.7	<1.0

N/A = Not applicable.
[a]Region considered to be a 20-mile corridor centered on proposed trunkline route.

by the proposed trunkline route (Table 1). The proposed route traverses several of the areas while other areas are crossed near their outer boundaries. The mileage of individual concentration areas crossed varies from less than two miles up to about 13 miles.

Pronghorn antelope occur along much of the proposed trunkline in grassland and shrubland habitats. Major populations occur in the sagebrush/grasslands of Wyoming and northwest Colorado. One area of critical winter habitat is traversed by the proposed trunkline near the Pathfinder Reservoir (milepost [MP] 239.5-246). Several fawning areas also occur along the proposed trunkline route but none are actually crossed.

Elk occur primarily in the region of the Parachute Creek drainage and in the Piceance Creek basin near the southern end of the proposed trunkline route. The majority of the elk that occur in this area winter at lower elevations in canyons and on south-facing slopes within the Parachute Creek drainage. Elk calving grounds are also common in the Parachute Creek area. Two areas of elk critical winter range are crossed in the Parachute area (MP 0.0-4.0 and MP 4.5-11.0). One additional elk critical winter range is crossed in Wyoming (MP 212.5-217.5).

Wild horses occur in the general area of the proposed trunkline route. In Colorado, only a small portion of the horses' range is intersected by the proposed trunkline route (MP 32.5-37.0). In southern Wyoming horses also occur (MP 110-145), but avoid the areas near the highway, along which the trunkline route is proposed. A few horses have also been reported in the Separation Flats area (MP 175-180).

Because little of the wild horses' range is encountered by the proposed trunkline route, and because of the dispersed nature of herds

and their mobility, no critical/crucial areas have been identified for wild horses.

Medium- and Small-Sized Mammals. Numerous species of medium- and small-sized mammals are known or expected to occur along the proposed trunkline route (WGFD 1979; Bissell 1978; CDOW 1978d; Rothwell et al. 1978). These mammals include various species of shrews, bats, rabbits, jackrabbits, chipmunks, ground squirrels, prairie dogs, gophers, mice, rats, voles, weasels, and skunks. One group of medium-sized mammals, the prairie dogs, could be of significance. Prairie dog colonies are important because they provide potential habitat for the black-footed ferret, an endangered species on the federal list. These colonies are generally present in grasslands and shrublands, frequently occurring in riparian and agricultural areas. The ferret is the only mammalian species listed as endangered or threatened by the U.S. Fish and Wildlife Service. An analysis of the potential impact of the proposed action on the ferret is being conducted and will be included in the biological assessment as required for Section 7 Consultation.

Birds. The diversity of cover types along the proposed trunkline route provides the habitat necessary for a wide variety of birds including several species of upland game birds, raptors, and waterfowl as well as numerous species of passerines (CDOW 1979, 1978a, 1978b, 1977; Dorn 1978; Kingery and Graul 1978; WGFD 1977).

Upland game birds expected to occur along or near the proposed trunkline route include sage grouse, blue grouse, mourning dove, ring-necked pheasant, and Gambel's quail. Of these birds the mourning dove is the most common and widespread. Seventeen sage grouse strutting ground/brooding areas and one blue grouse breeding complex are located along the proposed trunkline route (Table 1). The majority of sage grouse strutting grounds are located in the sagebrush/grassland type.

Strutting grounds are typically located in areas of low growing and sparse sagebrush stands. Sage grouse brooding areas are generally located adjacent to strutting grounds and in areas where ephemeral water sources are within 2-3 miles. Areas designated as sage grouse strutting/brooding complexes (Table 1) (according to CDOW 1040 maps) generally include habitat within a 2 mile radius of the center of major strutting grounds. The area near Spring Creek (MP 72.0-80.0) is designated as crucial riparian habitat, because, among other reasons, it is an important water source for nearby sage grouse brooding activity.

Several raptorial species are known to occur in the region of the proposed trunkline. In general, raptors have rather broad areal distributions even though certain species are commonly associated with specific vegetative types. Species known to nest in the vicinity of the proposed trunkline route include the golden eagle, red-tailed hawk, marsh hawk, ferruginous hawk, American kestrel, and Swainson's hawk. In addition, several non-breeding species are fairly common along portions of the proposed route during various times of the year, such as the bald eagle and rough-legged hawk during the winter (CDOW 1979; Fitzgerald 1981; Gettman 1981). The bald eagle and peregrine falcon are two federally-listed endangered species that are being considered in the biological assessment for Section 7 Consultation.

Waterfowl habitat along or near the proposed trunkline route is restricted because of a general lack of permanent water and high quality cover. Waterfowl habitat that is crossed by proposed trunkline route includes the river crossings at the White, Yampa, and Little Snake in Colorado and the Sweetwater, Horse, and Fish creeks in Wyoming. Waterfowl habitat that is not crossed by the proposed trunkline route but occurs within the region (20 mile corridor) includes the Sweetwater arm of Pathfinder Reservoir (MP 235), riparian vegetation

along Horse Creek (MP 237-243), and riparian habitat along the North Platte River (MP 240-278).

General descriptions of habitat quality and seasonal use in each of these areas is presented below:

- White, Yampa, Litte Snake rivers - Waterfowl use in each of these areas consists of seasonal use during migratory periods and limited nesting by permanent residents such as mallards. Habitat quality is considered fair.

- Sweetwater, Horse, Fish creeks - Waterfowl use in each of these areas consists of seasonal use during migratory periods and limited nesting by resident species. Habitat quality is comparable to the White, Yampa, and Little Snake.

- Sweetwater arm of the Pathfinder Reservoir - The reservoir is used primarily as a resting area during migrations (spring). Habitat quality is poor with little or no cover on the shoreline. Very little or no nesting is reported. Common species include mallards, pintail, teal, and gadwalls.

- North Platte - Seasonal use and some nesting by resident species. Habitat quality is considered fair and comparable to Sweetwater waterfowl habitat.

None of the waterfowl habitat affected by the proposed trunkline route is considered critical or crucial because:

- The amount of existing habitat is limited.

- Habitat quality is poor to fair.
- Existing habitat provides only limited nesting to other critical uses.

Reptiles and Amphibians. Many species of lizards, snakes, frogs, toads, and salamanders occur along the proposed trunkline route (Langlois 1978; WGFD 1977; Somers 1974). A list of these species may be obtained from the BLM District Office having jurisdiction over each particular region of the pipeline route.

Pump Stations

Pump stations are located within the major wildlife habitats discussed above. Crucial or critical habitats that occur at pump station locations are listed in Table 2.

Alternatives

Southern Rangely Lateral Alternative. The dominant vegetation type present along the Southern Rangely Lateral Alternative is pinyon-juniper. Small amounts of desert shrub, mountain shrub, and agricultural/riparian types are also present. Wildlife commonly associated with these types is expected to be similar to those species that occur along the proposed trunkline.

Large Mammals. Mule deer occur along the majority of this alternative route. Critical winter range is crossed by this alternative route at the mileposts listed in Table 3. Wild horses also occur in the vicinity of the southern lateral alternative, with the largest concentrations between MP 13-36. No critical/crucial areas have been identified for wild horses.

Table 2. CRITICAL/CRUCIAL WILDLIFE HABITAT EXPECTED TO RESULT FROM THE CONSTRUCTION OF PUMP STATIONS

Milepost	Critical/Crucial Wildlife Use Areas	Estimated Acreage In Region[a]	Estimated Acreage Disturbed	Percent Disturbed
0.0 (Parachute)	Elk critical winter range	19,164	10	<1.0
	Mule deer fawning	41,788	10	<1.0
71.0 (Maybell)	Mule deer critical winter range	320,677	3	<1.0
116.0 (Baggs)	Mule deer critical winter range	320,677	3	<1.0
188.0 (Rawlins)	None	N/A	3	N/A

N/A = Not applicable.
[a] Region considered to be the area within a 10-mile radius of the pump station location.

Table 3. CRITICAL/CRUCIAL WILDLIFE HABITAT DISTURBANCE EXPECTED TO RESULT FROM THE SOUTHERN RANGELY LATERAL ALTERNATIVE

Milepost	Critical/Crucial Wildlife Use Areas	Estimated Acreage In Region[a]	Estimated Acreage Disturbed	Percent Disturbed
1.0 - 5.5	Mule deer critical winter range	24,098	54.5	<1.0
6.0	Golden eagle Nest	N/A	N/A	N/A
7.0 - 11.0	Mule deer critical winter range	14,520	48.5	<1.0
12.0 - 12.2	Sage grouse winter concentration area	160	2.4	<1.0
13.0 - 15.0	Sage grouse strutting/brooding grounds	3,739	24.2	<1.0
14.0 - 14.5	Sage grouse winter concentration area	640	6.1	<1.0
15.0 - 16.0	Mule deer critical winter range	2,586	12.1	<1.0
17.0 - 19.0	Mule deer critical winter range	4,190	24.2	<1.0
18	Golden eagle nest	N/A	N/A	N/A
30.0 - 35.0	Mule deer critical winter range	5,645	60.6	1.1
40.5	Golden eagle nest	N/A	N/A	N/A

N/A = Not applicable.

[a] Region considered to be a 20-mile corridor centered on the Southern Rangely Lateral Alternative route.

Medium and Small-Sized Mammals. Populations of medium and small mammals that occur along or near the Southern Rangely Lateral Alternative are expected to be similar to those in similar habitat along the proposed trunkline.

Birds. Bird species expected to occur along the Southern Rangely Lateral Alternative are similar to those that occur in similar habitat along the proposed trunkline. One sage grouse strutting/brooding ground is located between MP 13-15. Two sage grouse winter concentration areas are present at MP 12 and 14.

Raptors known to nest along or near this lateral alternative include golden eagles and red-tailed hawks. The Southern Rangely Lateral Alternative passes within one mile of golden eagle nests at MP 6, 18, and 40.5.

Northern Rangely Lateral Alternative. Dominant vegetation types present along the Northern Rangely Lateral Alternative include sagebrush and pinyon-juniper. Smaller amounts of riparian and desert shrub are also present. The common wildlife associated with these habitats is expected to be similar to those species that occur along or near the proposed trunkline.

Large Mammals. The only big game species that occurs along the Northern Rangely Lateral Alternative is the mule deer. One mule deer critical winter range area is crossed by this alternative route (MP 4.5-14.5) (Table 4). Wild horses also occur in the vicinity of the Northern Rangely Lateral Alternative (MP 0-3.5), although the largest concentrations are located to the south in the area of Cathedral Bluffs. One critical/crucial area for wild horses is traversed near MP 1. At this location, wild horses depend on a developed spring as a water source. Disturbance to this area is not expected to result in

Table 4. CRITICAL/CRUCIAL WILDLIFE HABITAT DISTURBANCE EXPECTED TO RESULT FROM THE NORTHERN RANGELY LATERAL ALTERNATIVE

Milepost	Critical/Crucial Wildlife Use Areas	Estimated Acreage In Region[a]	Estimated Acreage Disturbed	Percent Disturbed
1.5	Golden eagle nest	N/A	N/A	N/A
3.0	Golden eagle nest	N/A	N/A	N/A
4.5 - 14.5	Mule deer critical winter range	116,436	121.2	<1.0
23.5	Golden eagle nest	N/A	N/A	N/A
26.0	Golden eagle nest	N/A	N/A	N/A
0.0 - 26.0	Bald eagle winter roosting	N/A	N/A	N/A

N/A = Not applicable.
[a]Region considered to be a 20-mile corridor centered on the Northern Rangely Lateral Alternative route.

a significant impact if an alternate water source is provided during pipeline construction.

Medium- and Small-Sized Mammals. Populations of medium- and small-sized mammals occuring along or near this alternative are expected to be similar to those along the proposed trunkline.

Birds. In general, the bird species expected to occur along the Northern Rangely Lateral Alternative would be similar to those occurring in similar habitat along the proposed trunkline. No strutting or brooding grounds are traversed by this lateral alternative although a blue grouse brooding ground is located within the 20-mile corridor.

Raptors known to nest along or near the Northern Rangely Lateral Alternative include golden eagles and red-tailed hawks. This lateral alternative passes within one-half mile of golden eagle nests at MP 1.5, 3.0, 23.5, and 26.0. Bald eagles are reported to utilize the White River corridor extensively as hunting and roosting habitat during winter months.

White and Yampa River Alternatives. The vegetation types and associated wildlife populations along these two alternative segments to the proposed trunkline route are similar to those existing along the proposed trunkline route. General lists of wildlife species present are available in various publications and are frequently available from state and regional offices of the Colorado Division of Wildlife and from BLM district offices. A number of publications that provide general information relative to wildlife densities by vegetation type, status of certain wildlife species, and ranges are available (Bissel 1978; Colorado Division of Wildlife 1978 a,b,c,d; Kingery and Graul 1978; Langlois 1978; Roughten and Sweeney 1978).

The location type, seasonal importance, and amount of crucial wildlife habitat that would be traversed by the two trunkline alternatives are presented in Table 5.

Table 5. CRITICAL/CRUCIAL WILDLIFE HABITAT DISTURBANCE EXPECTED TO RESULT FROM THE WHITE RIVER AND YAMPA RIVER ALTERNATIVES

Milepost	Critical/Crucial Wildlife Use Areas	Estimated Acreage In Region[a]	Estimated Acreage Disturbed	Percent Disturbed
<u>White River Alternative</u>				
0.0 - 3.0	Mule deer critical winter range	7,052	36.4	<1
5.0	Golden eagle nest	N/A	N/A	N/A
6.0 - 10.0	Bald eagle winter roost area	N/A	N/A	N/A
6.2	Golden eagle nest	N/A	N/A	N/A
7.5 - 14.5	Mule deer critical winter range	112,676	84.8	<1
<u>Yampa River Alternative</u> (Including Pump Station)				
0.0 - 1.0	Mule deer critical winter range	4,078	12.1	<1
6.0 - 10.0	Sage grouse strutting/brooding grounds	8,040	48.5	<1
20.0 - 33.0	Mule deer critical winter range	144,643	157.7	<1
22.0 - 23.0	Elk critical winter range and calving area	20,454	12.1	<1
26.0 - 30.0	Sage grouse strutting/brooding grounds	8,040	48.5	<1

N/A = Not applicable.
[a] Region considered to be a 20-mile corridor centered on the alternative routes.

ENVIRONMENTAL CONSEQUENCES

Introduction

It was determined through the scoping process that two categories of wildlife were of particular concern: 1) game species; and 2) those classified as endangered or threatened (federally or state listed). The potential conflict of construction activities having a direct adverse impact on these species in known crucial areas during certain periods of use was identified as being a potentially significant impact. Crucial or critical areas are defined as those areas important to the maintenance and perpetuation of wildlife populations. Generally these areas are characterized by population concentrations during critical periods, e.g., winter range, breeding, or brooding grounds. Within these areas, populations are very susceptible to human disturbance, and effects on individuals may result in the loss of several generations of progeny.

For these reasons crucial areas and use periods in conflict with the proposal were identified and seasonal restrictions on construction activities have been incorporated into the proposed action. These are expected to greatly reduce the potential of direct impacts on wildlife populations. In most cases, seasonal restrictions on construction were not suggested for crucial/critical areas where existing high use corridors, e.g. major highways or roads, are located adjacent to the proposed action. Exceptions include raptor nesting areas, where raptors may have acclimated to existing and constant vehicular disturbance, but may not acclimate to the introduction of new disturbances resulting from pipeline construction.

In order to evaluate the significance of construction impacts to critical/crucial areas due to habitat removal during non-crucial periods, i.e., residual impacts such as loss of carrying capacity, two criteria were considered.

1) Each crucial wildlife area identified through data compilation and personal communication with knowledgeable persons of the areas was analyzed to determine the relative extent of habitat disturbance that is expected to result from the proposed action and/or alternatives (Tables 1-5). If no more than 1 percent of the total available crucial habitat within the geographic area (a 20-mile wide corridor) is expected to be disturbed by the proposal, then the significance of that impact was considered to be low. If it was determined that more than 1 percent of the total would be disturbed the impact analysis was conducted in further depth to identify any possible significant impacts.

2) This criterion was applied if a finding of significance was made from criterion 1 (greater than 1 percent disturbance). When the amount of disturbance was found to be greater than 1 percent, further analysis determined whether the nature of disturbance would create beneficial or adverse impacts as well as short-term or long-term impacts to the wildlife resources. For purposes of this determination, the following definitions were employed.

Short-term:	lasting one year or less or affecting only one generation (year-class) of animals
Long-term:	lasting more than one year or affecting more than one generation of animals.

Endangered and Threatened Species. Endangered and threatened wildlife species are being considered on a case-by-case basis as part of the U.S. Fish and Wildlife Service Section 7 Consultation. All findings and determination of effects will be attached (when available) as a part of this section (entitled Biological Assessment).

Proposed Trunkline

Construction Impacts. Construction impacts associated with the proposed trunkline are as follows:

1) Criterion 1 Results. In three identified crucial/critical areas 1 percent or more of the available regional resource would be disturbed, MP 4.5-11.0, 4.5-5.0, 72.0-80 (Table 1). The type, location, estimated acreage, and percentage of disturbance in the remainder of critical/crucial areas (those with <1 percent disturbance) are presented in Table 1.

2) Criterion 2 Results. Significant impacts would occur in two of the three critical/crucial areas identified under Criterion 2.

Disturbance to a 100-ft corridor in sage grouse strutting/brooding grounds during nonuse periods is not considered a significant adverse impact. Strutting grounds are often located in areas characterized by sparse vegetative cover (generally low growing sagebrush) with large open areas. Therefore, it is likely that a cleared corridor would not prevent successful strutting activities after construction activities have ended. Sage grouse have been observed to return to strut on roads, pipelines and airport runways after the areas were developed (Harju 1979).

Disturbance to riparian habitat along Spring Creek is considered a significant impact for the following reasons:

- The impact would likely be long-term because of changes in the species composition from a native riparian plant association, e.g. willow, sedges, juncus, to introduced grass species. Recovery to native riparian plant association would not occur within one year.

- Impacts are considered adverse because the wildlife species that depend on the riparian community for a diversity of cover and food resources would not benefit from introduction of a monoculture of grass species. Local populations of sage grouse, which utilize the Spring Creek area as a brooding ground, would be particularly affected.

Disturbance to the 100-ft right-of-way (ROW) in elk critical winter range (MP 4.5-11.0) is considered a significant adverse impact for the following reasons:

- The impact would be long term because of changes in species composition from a mountain shrub association to perennial grass species, forbs, and other annuals. Recovery to a mountain shrub association would not occur within one year.

- Impacts are considered adverse because snow depth would prevent grasses from being available on most exposures except for south facing slopes.

  Note: The disturbance to elk critical winter range would not be considered significant if the ROW is limited to 50 ft between MP 4.5-11.0.

Generalized Impacts. Construction of the proposed trunkline would result in the alteration of about 3381 acres of wildlife habitat through the removal of existing vegetation and cover (e.g., rocks, logs, etc.). Some wildlife would also be lost during the construction period. This loss would consist primarily of species that seek cover rather than flee when alarmed (e.g., small mammals, reptiles, etc.) or those young present in nests. Large- and medium-sized mammals and various birds would generally avoid construction areas or flee from the area during such operations.

The species composition would be expected to change somewhat in the affected areas as a result of the clearing of the ROW. A species such as the deer mouse is expected to temporarily replace other rodents in disturbed areas; however, the preconstruction species composition should begin to return as native vegetation redevelops through plant succession. Since much of this line is proposed to be constructed adjacent to previously disturbed areas (e.g., pipeline and highway ROWs, the change in species composition might not be as dramatic as it would if the route traversed extensive areas of undisturbed native vegetation.

Effects on wildlife as a result of construction would be expected to be relatively minor with little significant impact on the various populations present. These impacts would be expected to be relatively minor because of the limited amount of habitat potentially disturbed in any one area (see Vegetation Background Report; Table 5) and the selective timing of construction activities in regions where crucial habitat (e.g., winter range, strutting grounds, etc.) exists (see DEIS Chapter 2).

Operation Impacts. Operation of the pipeline system would be expected to have negligible impacts on wildlife populations along the affected route for the following reasons:

- Location of the pipeline underground would allow the free movement of wildlife through the pipeline corridor.

- Regular maintenance inspections of the pipeline would be conducted primarily by aircraft. Surface traffic would be limited to valve maintenance and emergency repairs to the pipeline or erosion control structures.

- Use of the ROW by off-road vehicles could increase the potential for wildlife harassment and cause a general decline in the quality of wildlife habitat near the ROW. However, these effects would not expected to be significant since much of the pipeline route passes through accessible areas and parallels existing ROWs.

Fences across the ROW, especially on private land, tend to discourage off-road vehicle use of ROWs. The maintenance of open ROWs could result in the access of off-road vehicles to previously inaccessible areas.

Pump Stations

Construction and Operation Impacts. The clearing, leveling, compacting, and graveling of one 10 acre site and three 3 acre pump station sites would result in the loss of 19 acres of wildlife habitat. The acreage would be lost for the life of the project. In addition, some small and less mobile wildlife would be expected to be lost during construction; however, the larger and more mobile species

would be expected to disperse into adjacent habitats. None of the pump stations would result in the loss of more than 1 percent of the regional crucial wildlife habitat (Table 2).

Alternatives

Southern Rangely Lateral Alternative.

Construction Impacts. Construction impacts associated with the Southern Rangely Lateral Alternative are as follows:

1) Criterion 1 Results. More than one percent of the available regional resource would be disturbed at MP 30-35. The type, location, estimated acreage, and percentage of disturbance in the remainder of critical/crucial areas, i.e., those with less than 1 percent disturbance, is presented in Table 3.

2) Criterion 2 Results. A significant adverse impact would result from the disturbance to deer critical winter range at MP 30-35. Disturbance to the 100 foot ROW in deer critical winter range (MP 30-35) is considered a significant adverse impact for the following reasons:

- The impact would be long term because of changes in species composition from a mountain shrub association to perennial grass species, forbs, and other annuals. Recovery to a mountain shrub association would not occur within one year.

- Impacts are considered adverse because snow depth would prevent grasses from being available on most exposures, except for south-facing slopes.

Note: The disturbance to deer critical winter range would not be considered significant if the ROW is limited to 50 feet between MP 30-35.

Generalized Impacts. Construction of the Southern Rangely Lateral Alternative would result in the alteration of about 503 acres of wildlife habitat. The general effects of this alteration would be similar to those described for the proposed trunkline.

Operation Impacts. The operation of the southern lateral alternative would have similar effects on wildlife as would the operation of the proposed trunkline.

Northern Rangely Lateral Alternative.

Construction Impacts. Construction impacts associated with the Northern Rangely Lateral Alternative are as follows:

1) Criterion 1 Results. The results of applying criterion 1 (no more than 1 percent disturbance) to crucial areas along the northern lateral alternative (Table 4) indicate that no significant impacts will occur.

2) Criterion 2 Results. Not applicable.

Generalized Impacts. Construction of the Northern Rangely Lateral Alternative would alter about 429 acres of wildlife habitat. The general effects of this alteration will be similar to those described for the proposed trunkline.

Operation Impacts. The operation of the Northern Rangely Lateral Alternative would have similar effects on wildlife as would the operation of the proposed trunkline.

White and Yampa River Alternatives.

Construction Impacts. Construction impacts associated with the White and Yampa River alternatives would be as follows:

1) Criterion 1 Results. No more than 1 percent of any crucial area along either alternative will be affected by construction activities (Table 5). Therefore, construction during non-crucial periods should not result in residual impacts.

2) Criterion 2 Results. Not applicable.

Generalized Impacts. The general impacts associated with these two trunkline alternatives are anticipated to be similar regardless of the alternative. These impacts have been discussed in the proposed trunkline section.

Operation Impacts. Impacts associated with operation of these two alternatives are expected to be similar to those described for the proposed trunkline.

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